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ABSTRACT

All 22 papers presented at the 1982 meeting of the Association of Physical Plant Administrators are contained in these proceedings. The papers are organized under four topical areas: resource management, energy management, maintenance programs, and physical plant management. Resource management area papers offer advice on establishing a day cleaning program, disciplinary counseling, microcomputers in physical plant operations, what to do when receiving a work promotion, and the fiscal implications of collective bargaining in higher education. Energy management papers concern outside air units, retrofit lighting, and cogeneration. Papers grouped under maintenance programs deal with managing a maintenance manpower crisis, preventive maintenance, testing programs for hazardous chemical handlers, and asbestos assessment and control. Physical plant management papers concern quality control, public relations, vehicle fleet management, concentrated preventive maintenance programs, involvement in construction projects, and a computerized job cost control and billing system. Four general session papers discuss different aspects of managing the physical plant department. At the end of the publication, exhibitors are listed alphabetically by company name. A list of the convention registrants also includes their places of employment. (MLF)

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Proceedings of

The Sixty-Ninth Annual Meeting of The Association of Physical Plant Administrators of Universities and Colleges

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Hosted By:
Rocky Mountain Region

Vice-President for Programs
Seldon L. Kempton

June 6–9, 1982

Phoenix, Arizona

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Introduction

This Proceedings of the 69th Annual Meeting of the Association of Physical Plant Administrators of Universities and Colleges contains 22 papers presented at the meeting in Phoenix, Arizona, June 6-9, 1982. Readers desiring more information on individual papers should contact the authors.

Every presentation made at this year's Annual Meeting is included in the 1982 Proceedings. This year, for the second year in a row, we requested that the speakers send in camera-ready papers. All twenty-two speakers complied with our request making our job much easier and saving APPA more than $1,000. Another added benefit is that the Proceedings is ready two months ahead of the usual production schedule.

One copy of these Proceedings is being mailed to the representative of each APPA member institution, and to Affiliate and Subscribing members. Others who were official registrants at the meeting may also receive a copy upon request as long as the limited supply lasts. Copies may be purchased from APPA for $15 each, prepaid (including postage and handling).

Production of the Proceedings has been accomplished by Barbara Fatkin.

Paul T. Knapp
Executive Director

In Appreciation

APPA would like to thank the following individuals representing APPA member institutions for their contributions to the success of the 69th APPA Annual Meeting.

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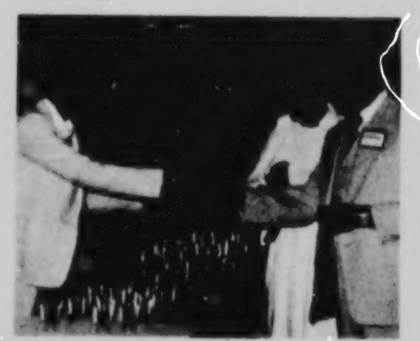
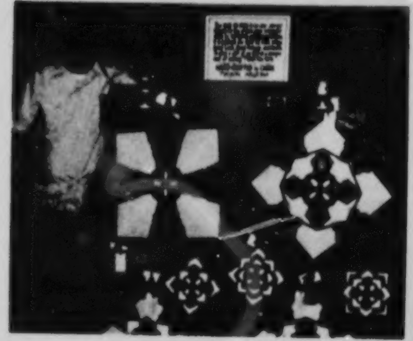
Photo Highlights of the Annual Meeting

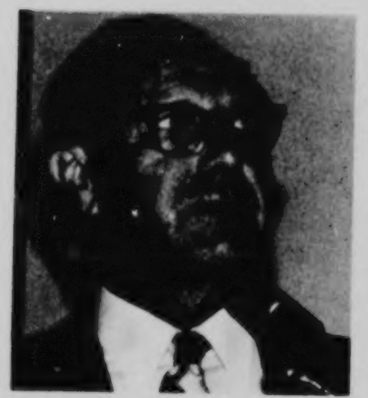


Sherry Reynolds Crittenden welcomes Charles Butler and Dorothy to the exhibitor's reception.

Eugene Hughes, president of Northern Arizona University, presented a highlight address.

Craftsman displays "Eye of God" weavings at the Arizona Arts of Then and Now show.





Harold Babcock, APPA president, addresses members at the Annual Banquet.

A Razzle Dazzle Review company entertains APPA members.

Thomas Smith passes the gavel to Harold Babcock.

APPA members attend one of the 24 technical sessions.

APPA spouses enjoy the results of a Mexican cooking demonstration.

H. Val Peterson (right) learns about a new product at the exhibit hall.

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Resource Management

PHOENIX '82
APPA

Establishing a Day Cleaning Program

By Robert A. Getz
University of Illinois
Chicago Campuses

Implementation of this type of program is no different than any other type of program. There are three basic steps: PLAN - ACT - FOLLOW UP. Each is equally important and failure in any phase will adversely affect implementation.

The first step of planning is very important. A detailed study must be accomplished. Everyone concerned must be informed. Failure to properly plan will adversely affect your action step and may result in scuttling the whole program. As a minimum, the planning phase should consider:

1. Building Survey: Your campus buildings should be categorized at least three ways. First, you should determine the various types of buildings on campus and their use then, draw up a list showing these various types of buildings (i.e., office, laboratory, special use, etc.). Also, break down your buildings by the occupants (i.e., doctors, students, staff, physical education, etc.). Categorizing your buildings in this manner will show you what you may expect to encounter. Then, pick your buildings for day cleaning by location. Whenever possible, switch buildings to days in close proximity to one another. This will allow your supervisors to work closely together with one another and support each other. Once you have identified those buildings to go on day cleaning, survey them individually and break them down by areas. Then, establish a routine for cleaning starting with the most congested areas and finishing with the least congested.

2. Meet with the Building Occupants: You want to establish a close rapport with the building occupants as soon as possible. Pick the level you wish to address, then, request meetings to discuss day cleaning. Before your meetings with the occupants, determine exactly what you will be able to do on a day-to-day basis. At the meetings, make them known as guarantees. You must be especially careful at this point because these guarantees will be the basis for the occupants' judging your success. You will also want them to identify one point of contact to work with your supervisors. The ideal is to have one point of contact per building, but, unfortunately, that is not always possible. It is also important to establish "who's boss." They must understand that the custodians report to the cleaning staff and not to the department being served. During the meeting, it is very important to listen to what the occupants have to say. It may be possible to solve particular problems at this point rather than waiting

until the action phase. It is much easier to solve problems during the planning phase.

3. Meet with the Custodians: The purpose of meeting with the custodians is to let them know what you expect. Establish a dress standard. The best dress standard is to provide uniforms, but that is very expensive. Designate break areas for their rest periods and lunch and do not allow anyone to carry radios. Provide instructions on how to act when they come in contact with occupants. Remember, these custodians will be the most visible people in your department and their actions will set the tone for how others rate your department. Finally, establish "who's boss." Insure they understand that they work for the cleaning staff and not for the building occupants.

4. Meet with the Supervisors: In your meeting with the supervisors, tell them what you expect from the custodians and advise them of the guarantees you made to the occupants. Insure they understand that the guarantees must be met day in and day out. Also, stress the importance of being sensitive to the particular needs of the occupants. Advise them to service those needs whenever possible. Establish "who's boss." Caution them not to give up their authority over the custodians. Provide them with an orientation of what is available on the campus. Remember, they have not had contact with those on days and are probably not familiar with what is available. Have them meet with the others in your department who work days and have them meet with the points of contact you have established in each building.

5. Clean Equipment: No matter what your reasons for establishing a day cleaning program may be, one of your primary concerns must be to establish an impression. That impression must be that you are providing a clean environment. There is nothing that will dull that impression more than dirty equipment. Wherever possible, provide your employees with new equipment. If new equipment is not available, insure that all of your equipment is cleaned before you use it in the work areas.

6. Public Relations Blitz: Just prior to the action phase, you must reach out to the 10 percent who never "get the word." There is nothing worse than a surprise. It puts people on guard and creates a negative impression. When a building is about to be switched to day cleaning, you must try to contact each and every occupant. Swamp the building with letters from your top administrators and provide memoranda which are suitable for posting on bulletin boards. Mention the fact that you are establishing a day cleaning program in the various meetings you attend. Invite your school newspapers to write articles about the program or submit them yourself. Remember, the object is to be as vocal as possible.

7. Union/Civil Service/Personnel: No matter how relaxed or strict your campus may be, switching employees from one shift to another will always involve some rules. Anyone who has any control over policies concerning employees must be consulted and advised of this program. You must comply with all the notification requirements, time constraints and rules regarding assignment of employees or you will open a "Pandora's Box" and jeopardize the entire program. This will be especially true if you do not have sufficient volunteers and encounter a situation where employees must

be forced to switch from one shift to another. Do not think that because you enjoy working a day shift, everyone enjoys working a day shift. You will be quite surprised at the number of reasons people enjoy working nights, and this will be one of the major stumbling blocks to overcome in establishing a day program.

A well-organized and coordinated planning phase allows for a smooth transition into the action phase. If you plan properly, everyone will be aware of what is to occur and their particular job in the program. When you implement your program, you are in the action phase and must pay particular attention to the following:

1. Flexibility: In establishing a day cleaning program, you must be flexible. It is impossible to formally structure a program of this nature. Once a routine has been established, your supervisors must be able to work the custodians in a changing environment. This is especially true during the action phase. Supervisors must be constantly alert to the occupants' needs and the environment. Problems will arise for which you did not plan. All of "Murphy's Laws" will be in effect during this action stage. It will test your supervisors' skills to the maximum, but they will learn from the experience and know their buildings. Insure they are prepared and allow them the authority to be flexible. This is not the time to be bureaucratic and paperwork must be kept to the minimum.

2. Talk to the Occupants: You need as much feedback as possible during the action phase. The more information the better. Insure your entire supervisory staff is out gathering information. You should also have some system of meetings to guarantee information is passed among the various members of your staff. If you discover a problem in one building, do not reinvent the wheel if that problem has already been solved in another building. Beware of who you assign to answer the telephones in your office. One of your best people should be assigned to this task. You want to provide a professional and competent image. The person assigned to the telephones should be constantly kept up-to-date and know how to handle people and complaints.

3. Visibility: Be conspicuous. Insure your custodians are out where everyone can see the cleaning tasks in operation. Tell them to greet the occupants in a friendly manner upon entering offices. Put one or two custodians at the entranceways to the buildings when it snows or rains. Close a washroom at mid-day so the occupants are aware that it is being cleaned. It is worth an occasional complaint to obtain the occupants' attention.

4. Custodial Behavior: The custodians need not bow down to the occupants, but they must be courteous and friendly. You must aim for a friendly, cooperative attitude. There is nothing worse than a grumpy or surly manner. It will negate all of your efforts and lead to complaints about the service. A positive attitude must always be emphasized.

Once you have "ironed out the bugs" and feel confident that you are operating your service at a smooth, even pace, the action phase ends and you enter the follow-up phase. This step in implementing the program is continuous. You must constantly follow through on all programs to insure continued success and an economical operation. The following ideas should be implemented upon entering this stage:

1. Questionnaire: Ask the occupants what they think of the program. Do not set up the questionnaire with leading questions to make the program look good, but leave it wide open to insure honest comments. Try to find out if the cleaning is better or worse and what they think of their custodian. Ask them to compare the current with the previous cleaning program. Leave sufficient space for comments and suggestions. The purpose of this questionnaire is to find out where your problem areas are so that they may be corrected.

2. Action on Complaints: When you receive a complaint, send a supervisor out immediately to investigate. Someone must talk to the occupant "face-to-face" to determine exactly what the problem is and the corrective measure. You will find that in most instances it is only a misunderstanding or very easy to correct. Unfortunately, if that molehill is left unattended, you will end up with a mountain. Once you think the problem is corrected, follow up with the occupant. Stop by or call and ask if they are satisfied. Try to determine if there is anything else you might do. This little extra effort will provide you with a satisfied customer.

3. Praise Workers and Supervisors: It is unfortunate, but managers seem to forget to pat people on the back for doing a good job. The typical manager is always out trying to do things better and correcting problem areas. There is nothing wrong with that and, in fact, that is the sign of a good manager. But, let us not forget we do have people doing a good job and let them know we are happy with their work. Try a Positive Report. Once each month, have all of your supervisors report the best thing that happened during the previous 30 days. Put it in memorandum form and send it out for posting on bulletin boards. It gives your people a chance to "blow their horns" and receive some recognition. If you receive a complimentary letter, post it where those responsible will see it. If a specific person is mentioned, write a cover letter and send it to the employee's home. That lets the employee's family know you appreciate them and gives a nice boost to morale. Also, do not always bring up problems at meetings but spice up your meetings with positive reinforcements by telling them what is being done well.

4. Continued Visibility: Do not let your people hide. Insure they stay visible so that the building occupants may see that you are keeping the environment clean. Encourage your people to become members of the campus community. You want everyone to know your cleaning force is on campus doing their job.

5. Constant Dialogue with Occupants: Keep your supervisors out in the buildings in contact with the occupants. Keep the lines of communication and coordination open. Maintain a system of internal meetings so that solving techniques may be passed between buildings. Remember that you are a service-oriented operation that depends on customer satisfaction.

6. Continued Public Relations: Maintain your contact with the campus newspapers. Let them know when your crews have accomplished a difficult task or achieved a goal. Provide special cleaning efforts whenever

possible. If you know a department is receiving an accreditation visit, offer to provide a special cleaning of their offices and areas. If they have visitors coming to discuss a donation, make sure you take care of them. Never pass up an opportunity to service the special needs of a department.

There are two threads which run through each phase and hold this program together. Those threads are communication and coordination. Without them there will be no program. Throughout the establishment of this program, everyone involved must be informed and work together. They must talk to one another and support one another in satisfying the customer.

Disciplinary Counseling

By Patrick Cunningham
University of Michigan

Introduction

Most supervisors regard the administration of discipline as perhaps the most stressful and onerous task they perform. Certainly no one enjoys disciplining a subordinate, and every effort should be made to correct a problem prior to administering discipline. The vast majority of our employees will never encounter the disciplinary process. As responsible employees, there is no need to impose these sanctions, and any problems or disagreements that occur between the supervisor and these employees are minor and are worked out informally.

Unfortunately, not all employees are responsible, and the informal means for correcting problems may prove unsuccessful or the problem may be so severe that a stronger response from the supervisor is required. These employees, for whatever reasons, are unable or unwilling to meet normative behavioral standards in the work place, and their behavior, now misconduct, has become disruptive. The supervisor must then restore order to the work environment by modifying the employee's behavior, or as a last alternative, by discharging the employee.

The most accepted and prevalent method for correcting misconduct and modifying employee behavior is through the use of corrective discipline. Most colleges and universities utilize a corrective discipline procedure, which for common forms of misconduct, like absenteeism and unsatisfactory work performance, begins with the oral reprimand. If the administration of the oral reprimand does not correct the misconduct, more severe sanctions are imposed, including written reprimands, disciplinary layoffs and ultimately discharge.

Most labor contracts and many university policy guides or employee handbooks reference that an employee will not be disciplined or discharged without "just cause". Corrective discipline helps assure that employees who are ultimately discharged were adequately warned and given a chance to correct their misconduct, thus documenting "just cause" for the discharge. This helps management win arbitration cases, discrimination charges and unemployment claims.

Disciplinary counseling, or the use of the oral reprimand, is the cornerstone of any corrective discipline procedure. A philosophy and practice of "corrective discipline" maintains that disciplinary problems should be handled at the lowest level possible and that further actions (letters, layoffs, discharges) are built upon the oral reprimand.

As the first step in the disciplinary procedure, disciplinary counseling, when correctly administered, is the most effective method for correcting misconduct. It is the only step that offers two-way communication, since letters and layoffs are essentially unilateral actions. Disciplinary counseling is also the only oral step in the disciplinary procedure and encourages mutual cooperation and peaceful resolution of problems. Once you "go in writing" the inherent conflict in a disciplinary confrontation dramatically increases, and an employee may perceive the correction of his/her behavior as a lost cause, since presumably their record and future prospects are already ruined.

The Myths of Disciplinary Counseling

Disciplinary counseling skills are often underrated by supervisors, managers and even personnel professionals. For this reason, many supervisors are not effective in their use of the oral reprimand and rely too heavily on the harsher forms of discipline, like written reprimands and disciplinary layoffs. This is unfortunate, and often leads to additional disciplinary problems; problems which might have been avoided had the supervisor been more skillful in administering the oral reprimand(s).

I am convinced that the casual and sometimes sloppy attitude with which some supervisors administer oral reprimands occurs because they believe one or more of the following myths:

Myth #1

As the only oral step in the disciplinary process, successes and failures in this arena go largely unnoticed by others in the organization. While the more progressive forms of discipline are in writing and will be more immediately visible to the supervisor's supervisor, those supervisors who are effective in administering oral reprimands will have less problems later. Therefore, supervisors who spend more time and effort on this process will be handsomely rewarded by less incidence of written reprimands, disciplinary layoffs and discharges.

Myth #2

Disciplinary counseling skills are simply an extension of good interpersonal communication skills, and are natural as opposed to acquired skills. Supervisors who believe this myth will devote little or no time to planning and preparing for a disciplinary counseling interview, establish no counseling goals and conduct the interview like an informal conversation. No wonder some employees come out of such an interview utterly unaware of the severity of the problem, with little or no idea of what is expected of them, and oftentimes even unaware that they were disciplined. We have found at The University of Michigan that disciplinary counseling skills are not naturally acquired, but must be learned and practiced. Therefore, a somewhat formal, systematic approach to disciplinary counseling is advocated.

Myth #3

Disciplinary counseling is like other forms of personal counseling. In other forms of counseling, goals and outcomes are often negotiable. It is often a matter of the counselee (the employee in this case) making revelations about himself or herself and coming up with solutions. Disciplinary counseling, on the other hand, must be controlled by the supervisor, who has definite goals in mind which may not be negotiable. Although revelations from an employee about personal problems may be valuable to the supervisor, these types of revelations are not necessary to have productive disciplinary counseling. Supervisors must be careful not to allow a disciplinary counseling session to degenerate into a "gripe" or "bull" session. This is not only a waste of work time, but also may deter the supervisor from reaching the counseling goals.

Training Program

To emphasize the importance of disciplinary counseling skills and destroy some of the myths attached to the process, the Plant Department at The University of Michigan has developed a training program on disciplinary counseling. A seven-step, structured procedure for conducting a disciplinary counseling interview has been developed, which is the mainstay of the training program.

The seven steps of disciplinary counseling

1. Always counsel in a private place, out of the work area (disciplinary counseling is not idle conversation). Supervisors are encouraged to make an appointment with the employee in advance, plan and establish counseling goals, conduct the counseling session in a private office, and use a formal tone. If the session gets a bit uncomfortable or tense, this is not all bad, as it reinforces the seriousness of the situation and problem.

2. Identify the problem or incorrect behavior. Be as specific as possible. Supervisors should point out actual incidents of misconduct when possible. They should also explain the effect of the misconduct on their unit and on other employees. Avoid generalizations like, "you've got a bad attitude, John." These expressions mean different things to different people and do not lend themselves to clear interpretation.

3. Identify the correct or desired behavior. Show the employee just how he or she should behave. A supervisor must never assume that the employee knows how to correct his or her behavior. The employee may have a completely different value system than his supervisor has. For example, I have met employees who put no great importance on absenteeism from work, while most supervisors understand and value good attendance. It is the supervisor's job to tell the employee what is valuable to the supervisor and organization and exactly what is desired. You may not be able to change the value system of an employee, but you can certainly make it clear what the organization expects.

4. Define the consequences of continued misconduct. Supervisors must make the employee aware that any further instances of misconduct will lead to additional disciplinary action, e.g., a written reprimand. Do not try to avoid a confrontation by skipping this step. The employee deserves to know just what will happen if the misconduct continues. Later disciplinary actions (if necessary) will be better received if they do not come as a surprise.

5. Try to get a commitment from the employee. Our supervisors are trained in methods to get the employee to acknowledge that he or she has a problem and will try to solve it. They are cautioned, however, not to try to force a confession out of an employee. An employee may silently agree with a supervisor's analysis of the problem, but may be unwilling to admit it verbally.

6. Identify the session specifically as an Oral Reprimand. The employee should be made aware that counseling is the first step in the disciplinary process. It has been my experience that many supervisors fail to inform the employee of this fact. Employees who are not informed often become upset about later references in a written reprimand that they were counseled. In their minds they might have had a conversation with their supervisor, but they did not regard it as a form of discipline.

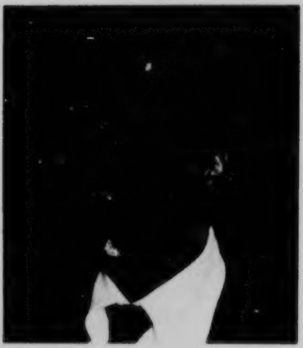
7. Monitor and follow up. Supervisors are instructed to explain to the employee that his or her behavior will be monitored closely in the future. A supervisor should always follow up the counseling at a later date. We suggest that the supervisor make notes about what was said and place them in a tickler file to facilitate follow up actions. It is just as important to follow up with an employee who has corrected the misconduct. Not only does this take some of the pressure off an employee who is conscientiously striving to correct a problem, but it also gives the supervisor a good opportunity to offer positive feedback and encouragement.

All Plant Department supervisors go through a four-hour program on disciplinary counseling. It begins by attacking the myths of disciplinary counseling and an introduction to the seven-step process. With a rare exception, all the supervisors admit that they have been delinquent in this responsibility and should cover these steps. They are then instructed that unless they follow every step in the process, they have not, in fact, administered an oral reprimand. The remainder of the training session is spent to discuss and analyze common disciplinary problems and practice the new procedure through role playing exercises.

Conclusion

The importance of developing good disciplinary counseling skills cannot be overstated. It is the first and most effective step in the corrective discipline procedure. While the development of these skills is not easy, those supervisors who become skillful in this process will be handsomely rewarded for their efforts through less incidence of disciplinary problems and turnover.

The Plant Department at The University of Michigan recommends a seven-step approach to disciplinary counseling. This systematic approach to the oral reprimand offers many advantages. Contrary to what might be expected, even in the unionized environment here at The University of Michigan, this more formal, structured approach to disciplinary counseling has been better received by our employees. It certainly promotes consistency of application, and should leave no doubt in the employee's mind that he or she was disciplined and what to expect in the future if the misconduct continues.



Coming Up Through the Ranks

By George B. Wright, Vice President
Service Engineering Associates, Inc.

A lot of thought is given to advancement; we do not spend enough time thinking about it and preparing for it. Advancement can come in several ways. A promotion can come from a supervisory position, transfer from another department or as someone hired from the outside.

Ideally, many considerations about the job would have taken place before the promotion or hiring. The promotion is like taking over a new business. You would not make immediate changes without learning a lot about your new job responsibilities and taking an inventory of things, people and situations.

I. Some Things To Do

A. Interviews with management

(1) departmental objectives and limitations, (2) budget system, (3) union, civil service, "red-lined personnel", (4) organizational rules, disciplinary procedure, (5) learn the work habits and practices of your boss, and (6) reach a clear understanding about your responsibilities (general and specific) and the extent and limitations of your authority.

B. Interview heads of other departments and supervisory personnel in your department and enlist their help and suggestions but make no promises and threats.

C. Meet with union or civil service representatives, keeping them informed, but do not ask their permission.

D. Meet with the workers

(1) reassure them on the subject of job security, (2) stress that you will evaluate them on work performance, following the rules, and interfering with other people, and (3) if approved by management, state that staff reductions (if any) will be made by normal attrition.

II. What About Support Areas

(1) supervision, (2) support staff, (a) secretarial, (b) stock clerk, (c) truck driver, and (d) training director, (3) workers, (4) contract work (5) equipment, (6) supplies, (7) legal factors, (8) work facilities, (9) budget history, (10) operational manual (a) work units, (b) procedures,

(c) frequencies of job performance, (d) floor plans and maps, and (e) schedules and printouts, (11) time standards, (12) previous consulting reports, (13) supervisory development program, (14) worker training program, (15) motivation and morale-building activities, (16) communications, (17) transportation, (18) records kept and (19) reports rendered.

Some emergency action may be taken in the areas of safety, fire-prevention and body mechanics.

III. Here are some memory aids for getting started on a firm foundation.

(1) have your work force and staff see you as a confident person, (2) show energy, (3) display good humor, (4) you cannot legislate respect; earn it by setting the best possible example, (5) listen carefully, (6) take action only after asking opinions, getting facts, careful consideration, (7) keep your people informed about your plans and actions; involve them whenever you can, (8) admit your mistakes; predict that you will make more of them, (9) be yourself, (10) back up your people, (11) be predictable and consistent, and (12) practice the 4F's - fair, firm, factual, friendly.

Collective Bargaining and Its Fiscal Implications in Higher Education

By Jerry C. Lee
Gallaudet College

Collective bargaining is now a fact of academic life. The growth rate of faculty and staff unions on college and university campuses over the past ten years has been a steadily increasing one, and there are no current indicators of a swift end to that trend. The repercussions of collective bargaining on campus are vast and can influence such diverse issues as faculty governance or custodial leave policies. However, the economic impact of unionization upon an institution's financial resources is one of the major and most immediate effects that accompanies bargaining. This paper will explore the fiscal implications of collective bargaining and attempt to describe some of the administrative and financial management changes that may result from the advent of collective bargaining on campus.

The Affluent Academe

The decade of the fifties and the early sixties was an era of unprecedented growth and expansion in American higher education. Financial support for public and private colleges and universities was available from a variety of sources and generally funds were abundant. While the prosperity was not shared by all, the academy as a whole could be described as affluent.

With the launching of Sputnik, in 1957, the federal government practically declared a national emergency in the state of American higher education. Congress focused its attention on expanding the avenues of access to college and university degrees and particularly encouraged careers in teaching, engineering and the related physical sciences. The National Defense Education Act helped many students, who otherwise would have been unable to attend, finance college and university educations. Federal grant and research money encouraged curriculum innovation and faculty expansion as well as increases in the size of physical plants. More students than ever were applying to the nation's colleges and universities, qualified faculty had more job mobility and security than in the past, and administrators had more money to administer. The space race had a substantial impact upon American higher education, and business was booming.

Commerce and industry also contributed to the expansion of higher education. It was the opinion of many that education could improve the quality of American life and that investing in higher education was worthwhile in both the long and the short term. An educated populace was considered a resource that represented a significant portion of the capital available to society. Since capital is determined by its ability to provide for future satisfactions, higher education was perceived to be a good capital investment because it would provide eventual profits to the society. The rationale for this belief was based on an investment theory of educational demands which held that an individual would purchase an education if the present value of the expected stream of benefits resulting from education exceeded the present cost of acquiring the education. Business and industry provided monetary support to colleges and universities, directly in the form of gifts or endowments and indirectly in the form of scholarships to students and by offering the use of specialists with professional management expertise.

Societal attitudes and philosophies during this period also encouraged the growth of colleges and universities. Education was unquestionably adopted as the cure for a number of social ills and injustices. A college or university diploma was considered an automatic escalator to a higher socio-economic level.

Traditional line item budgets were (and often still are) popular because essentially the only budget development required was to define the costs of the resources required by each operational unit within the institution. This method of budgeting did not relate dollars spent to desired objectives. However, the financial climate was solvent enough that educational administrators concentrated their efforts on expanding their educational programs rather than considering the results which were desired from the investments and expenditures made in these new programs.

The New Depression

By the late 1960s, the period of prosperity came to a halt. Institutions found themselves trying to cope with changes in their financial environments. Funding sources began to question the results of the programs they were financing and asking whether the results justified the costs. Taxpayers began to wonder whether the monies normally earmarked for higher education would serve their interests better if they were applied to needed social service programs. Student interest in higher education began to waver, enrollments declined, inflation forced many institutions to cut back and, in a few instances, to close.[1] Administrators were now being asked to justify their budgets, and many college and university business offices were too unsophisticated to meet the complex financial and budgetary demands suddenly required of them. The final report of the Carnegie Commission on Higher Education described the change this way: "Institutions of higher education escaped their traditional genteel poverty after World War II; they even became newly prosperous. But a new depression has quickly followed the new-found prosperity, and it is likely to be more enduring--higher education has moved from genteel poverty to genteel poverty in one generation."[2]

The academician turned to industry for management models, and progressive management systems quickly became an integral part of college and university administrative style. Accountability became the expected standard and, with its acceptance, significant changes were implemented. Campuses adopted numerous management techniques, models, and concepts including management by objectives; zero base budgeting; planning, programming, budgeting systems; management information systems; quality assurance; and cost-effectiveness programs to assist with their financial management efforts. The systems approach to management that had been taught on many campuses but rarely applied in educational institutions began to be used to support the planning, organizing, evaluating and controlling capabilities of colleges and universities. These methods helped to modernize educational decision-making by providing more comprehensive information in a timely manner. Tailoring these various management systems to the needs of individual institutions allowed the educational administrator to take advantage of new technology and to use these management techniques to help meet financial obligations and help solve fiscal problems.

Collective Bargaining: A New Challenge

Concurrent with the development of the financial depression in higher education, another major challenge emerged: collective bargaining. Collective bargaining in higher education is generally perceived to be a recent phenomenon; but that perception is not totally accurate. In the 1940s, several colleges and universities had collective bargaining agreements with unions. Since the early seventies, however, there has been a notable increase in the number of unions within academia.

When the National Labor Relations Board (NLRB) assumed jurisdiction over private colleges and universities in 1970, the impetus for collective bargaining on campuses received another incentive. In the landmark Cornell University decision [3] the Board extended collective bargaining rights to non-supervisory employees at approximately eighty percent of the nation's 1,450 private institutions[4] and included in its jurisdiction all private, non-profit institutions whose annual gross revenue was at least $1 million. "The Board calculated that this standard would bring approximately 80 percent of private colleges and universities and 95 percent of all employees under coverage of the Act [the National Labor Relations Act]."[5] This decision reversed an earlier Board ruling involving Columbia University in which the NLRB had declined jurisdiction over non-supervisory employees in private colleges and universities.

Scarcity of Resources

The eighties have ushered in another milestone in the history of higher education. Increasing costs coupled with decreasing revenues have placed many institutions in an untenable financial position. Current data on the economic health of colleges and universities indicate that the financial condition of higher education is precarious. As a result of a rapidly declining birth rate and high tuition costs, a downward trend in enrollment is predicted until at least the turn of the century. The Carnegie Commission predicts that by 1986, more than 400 colleges and universities will have either closed, merged, or experienced some other change of control. Additionally, tax support of higher education has failed to keep up with inflation. Spending caps and reduction measures were legislated in twelve states by 1979; since then forty-five states have considered similar limitations on aid to higher education. In a losing bout with inflation, endowments at 144 colleges and universities by 1978 had experienced about a 5 percent real decline in purchasing power by 1978. Finally, if the GNP grows at its projected annual rate of 2.8 percent and if undergraduate enrollment declines by a projected 10 percent, higher education will drop to 1.76 percent of the GNP by 1998, compared with the 1978 level of 2.39 percent.[6]

In a recent editorial, Lester C. Thurow described the academy as being in the "Bail Out" stage. Commenting in Newsweek, Thurow wrote: "Because of demography, education is a declining industry. Unfortunately, declining industries are almost always dying industries. With declining enrollment there are few new job opportunities and little influx of new talent. As opportunities for advancement and promotion disappear, the people with external job opportunities, often the best people, bail out. Intellectual rigor is replaced with intellectual, sociological and administrative rigor mortis. Almost no one manages a dying industry well, and education is no exception. Educational bureaucracies become worse, not better, in their death throes. Yet no country can afford to let its education and training systems die".[7]

The emergence of collective bargaining on the campus permeates the milieu of academia in a significant way. Since the stated objective of most unions is to improve the economic status of their members, there is cause for college administrators to be concerned. Higher education is a labor-intensive environment in which the expenditures for salaries and benefits generally represents about seventy to seventy-five percent of the operating budget. If organized labor pushes for more economic gains, in the face of shrinking resources, the response may very well be to reallocate resources and to decrease personnel. Yet job security is also a major union goal. The possible collision between collegiate administration and organized labor is obvious and may be inevitable.

In union campaigns, faculty and staff are continually reminded that the National Labor Relations Act (NLRA) guarantees certain legal rights. The NLRA's definition of collective bargaining, which has also served as a model for many state labor relations statutes states that:

> For the purpose of this section, to bargain collectively is the performance of the mutual obligation of the employer and the representative of the employees to meet at reasonable times and confer in good faith with respect to wages, hours, and other terms and conditions of employment, or the negotiation of an agreement, or any questions arising thereunder, and the execution of a written contract incorporating any agreement reached if requested by either party, but such obligation does not compel either party to agree to a proposal or require the making of a concession.[8]

The language clearly states that the involved parties must bargain over economic issues. To many prospective union members this is rather naively interpreted as an assurance of increased remuneration regardless of the fact that many institutions simply may not have more to give. It is true, however, that once table agreements become part of a negotiated contract, faculty and staff groups are assured that salaries and benefits cannot be changed arbitrarily or taken away simply because an administration wishes to reallocate such funds to other purposes. What is most significant is the fact that both parties must bargain over economic issues making the fiscal reverberations of collective bargaining on campus inevitable.

Although the picture being painted is a bleak one, opportunity can be the offspring of adversity if these trials are perceived to be challenges for change. It is essential then, that we fully comprehend all of the costs associated with collective bargaining so that informed decisions can be made. Although collective bargaining has undesirable fiscal consequences, these consequences need not necessarily have negative affects on the total collegiate management function.

Organizing Campaigns

To those institutions who have yet to embrace collective bargaining, the message is a succinct one: Stay that way! Although it is not acknowledged on the balance sheet, clearly being union free is a tangible institutional asset. If, however, union organizing attempts occur, the singular critical decision is determining how much of the institution's resources will be committed to opposing the union campaign. Too often, administrators lose elections to unions because they perceive unionization on their campuses as inevitable and do little to oppose it. Election losses also occur because of unsophisticated election campaigns, administrative mistakes, insufficient campaign resources and an inability to communicate the administration's position. However, unions do lose elections. In fact, in recent years unions have lost more than half of the elections conducted each year by the NLRB. Despite intensive union activity, approximately three-quarters of the total work force remains unorganized.

In addition to remaining union free, a well-planned and well-conducted pro-administration campaign can improve communications and heighten mutual understanding between the institution and its faculty and staff members.

Direct and Indirect Costs

One of the obvious ways to calculate the fiscal implications of bargaining is to examine the direct and indirect costs involved. Direct costs are the funds required to support the office or department that is responsible for representing the institution in collective bargaining. Normally these duties are carried out by the Director of Personnel, a Director of Labor Relations or legal counsel. Support personnel and resources including secretarial help, assistants' salaries, equipment and similar items are also part of these direct costs.

Indirect costs are those expenditures that cannot be as clearly identified. An example would be the cost of implementing an overall change in institutional policy. The time required for policy making incurs the greatest indirect cost because it requires the involvement of administrators at the highest levels -- individuals whose attention is more effectively directed to and most needed for other matters.

Indirect costs also include the relationship of union groups to non-union groups. For example, granting a concession to one group usually requires making a concession to another. While indirect costs are often overlooked, they have significant implications for the future of the institution.

It is imperative that all of the potential costs resulting from the advent of collective bargaining be identified, analyzed and determined well in advance of any bargaining commitment. Not only will this pre-preparation result in a contract with which the institution can live; it will also allow the institution to improve its overall finanical planning capability. Failure to recognize the potential hidden costs can lead to economic catastrophe.[9]

Planning

The most basic requirement of the negotiating process is planning. In order to survive at the bargaining table, educational administrators must be in a position to plan for and forecast their institution's financial requirements. "The institution's knowledge of its present state and its anticipated growth patterns in the personnel area is a minimal requirement [for bargaining]. This type of internal data information becomes a key component to cost analysis projects which will be used to inform the decision-making process for the university in collective bargaining."[10]

One of the first steps in preparing for collective bargaining is to perform a thorough analysis of the union's demands and the possible impact of these demands on the financial structure of the institution. All demands should be costed out as fully as possible to determine their true value. This is the only way that meaningful decisions can be made about union demands. Often the most seemingly innocuous union demands create the most disastrous long-term financial difficulties. Relating a union's economic demands to an institution's long- and short-term financial situation puts the institution in a better position to plan budgetary actions. The residual effect of this type of planning can also be very beneficial to other operations within the institution. When costing out union demands, it is necessary to study the implications of the demand in the event that the same concession is made later to other union and non-union employee groups.

Perhaps the simplest way to cost out union demands is to group the union's "wish list" into appropriate categories so the true real costs can be analyzed. One possible grouping would be the following:

I. Compensation

    A. Direct compensation for work

        1. Hourly, weekly, or monthly rate
        2. Overtime
        3. Shift differential
        4. Call-in pay
        5. Salary increase adjustment

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    6. Cost-of-living or inflation adjustment
    7. Performance bonus
    8. Longevity pay

  B. Direct compensation for non-work

    1. Annual or vacation leave
    2. Sick leave
    3. Personal or administrative leave
    4. Holidays
    5. Jury witness leave
    6. Bereavement leave
    7. Military leave
    8. Maternity/paternity leave

II. Benefits

  A. Statutory benefits

    1. Unemployment compensation
    2. Workman's compensation
    3. Social Security

  B. Potential benefit pay-outs

    1. Retirement insurance
    2. Sick leave
    3. Disability insurance
    4. Health insurance
    5. Dental insurance
    6. Optical care
    7. Leave of absence (without pay)

  C. Institutional benefit program

    1. Supplemental annuity tax shelter
    2. Sabbaticals
    3. Professional development
    4. Tuition assistance (Faculty/staff)
    5. Educational assistance (Faculty/staff dependents)
    6. Parking
    7. Travel insurance and fees

III. Academic related cost

    1. Tenure
    2. Rank and promotional programs
    3. Non-"RIF" guarantees
    4. Class size
    5. Teaching load
    6. Support facilities and personnel

IV. Organized labor related cost

1. Administrative time and preparation cost
2. Legal counsel
3. Check off provisions
4. Staff support
5. Steward pay
6. Release time for bargaining committee members

Institutions can develop cost estimates by using their own system of costing or one of the models that is available. For example, Chamberlain's definition of bargaining power and the relative costs of agreement and disagreement has two factors: (1) A's bargaining power and (2) B's bargaining power. A's power is the ratio of the cost to B of disagreeing on A's terms, to the cost to B of agreeing on A's terms as assessed by B. B's power is the ratio of the cost of A of disagreeing on B's terms to the cost of A of agreeing on B's terms as assessed by A. Therefore,

$$\text{A's power} = \frac{\text{Cost to B of disagreeing on A's terms}}{\text{Cost to B of agreeing on A's terms as assessed by A.}}$$

$$\text{B's power} = \frac{\text{Cost to A of disagreeing on B's terms}}{\text{Cost to A of agreeing on B's terms as assessed by B.}}$$

Thus: A's power $\underset{>}{\underline{\quad < \quad}}$ B's power

Further, Chamberlain suggests that each party convert all bargaining demands into dollar equivalents. The result is a set of comparisons of the net dollar advantage or disadvantage of potential agreements. The cost of collective bargaining depends on the party's bargaining power. The purpose of this model is to assist each party in obtaining as much power as possible.[11]

Another approach is the discounted cash flow model. The discounted cash flow model is a management technique that is widely used to evaluate long-range expenditure proposals. The model focuses on the cash receipts and disbursements associated with a proposal and explicitly and automatically weighs the time value of money. The model requires an administrator to identify the cash inflow and outflow associated with a proposal and discount them back to the present, i.e., adjust the flows to consider interest that is gained or lost because cash is to be paid or received in the future rather than the present. Other things being equal, the administrator would select the proposal requiring the smallest discounted cash outflow or the largest discounted cash inflow.[12]

There is no doubt that collective bargaining is costly. How costly it is depends on the nature of the agreement, the preparation of the parties involved, the administration of the contract and other related matters. As the National Commission on the Financing of Postsecondary Education has noted, higher education is "...one of the few major industries without formal price and cost-index information specifically tailored to institutional and consumer needs."[13] In a speech presented at the First

Annual Conference for the National Center for the Study of Collective Bargaining in Higher Education, Dr. David Newton, Vice Chancellor for Faculty and Staff Relations, CUNY, "...[it is] an educated guess that at the City University of New York, we have spent, conservatively, on the average of two million dollars a year in financing our bargain." As Dr. Newton said collective bargaining "ain't no bargain."[14]

Additional Administrators

Collective bargaining may also mean hiring administrators who have the kind of experience and training that fosters efficient financial management. In fact, collective bargaining has created many new administrative positions and spawned an increasing number of collegiate specialists including negotiators, personnel and compensation technicians, researchers, attorneys, cost accountants and budgeting and planning specialists. One potential result of this practice has been the creation of a core of management specialists who can refine and enhance the management practices of their colleges and universities. By using specialists who have the expertise to make decisions that will maximize the institution's resources, greater efficiency and increased economy can be achieved. Institutions can ill afford to appoint administrators to important fiscal positions whose only credentials are previous teaching experience or because the Dean "feels they need administrative experience." Naturally, an offsetting feature of employing such specialists is the cost. The salaries, benefits and support resources required for these employees can be an extremely expensive investment for the institution. However, the long-term cost savings realized through the refined financial planning and applications developed by these specialists could be substantial.

Because of the intricacies and complexities of collective bargaining, the importance of having access to competent labor counsel cannot be understated. While administrators should not abdicate their responsibilities by assigning them to an attorney, labor counsel should occupy a prominent role in the collective bargaining process. In addition to preventing costly litigation, counsel can, as necessary, protect and establish important institutional rights. The adage "discretion is the better part of valor" is a truism. Unfortunately, administrators often make decisions based solely on preconceived fears of litigation. Although the potential legal cost that can ensue from litigation should be factored into the decision making process, the ultimate decision to pursue a course of action should rest on what is right, proper and in the institution's best interest. If litigation be a consequence of that decision, so be it.

We have recently seen an extraordinary break-through for academic administrators as a result of the Yeshiva decision. This decision [NLRB v. Yeshiva University 444 U.S. 672 (1980)] held that a college administration may refuse to negotiate with a union representing faculty, if the following criteria are met: (1) the faculty participates in decision making; (2) faculty members act in the interest of the employer and are accountable to managerial policies and (3) faculty possess supervisory authority.

As a result of the Yeshiva decision, by June 1981 approximately thirty-seven schools refused to bargain and twelve schools refused to bargain for a successor agreement. Where a union was certified but no contract signed, some universities refused to continue negotiations. Clearly legal proceedings can be costly; but as evidenced by the results of the Yeshiva decision, the benefits can exceed the cost.

Computerized Information Systems

Accompanying the need for education management specialists is the necessity for information systems that will support their efforts. Collective bargaining is an adversarial process in which both parties attempt to obtain more and seek to protect their constituents' interests. One resource required at the bargaining table is data, derived internally and externally, to support or assist in clarifying the position of the negotiator. These data may be obtained through various planning package information models, surveys, consultants and external sources. It is also essential to have a detailed analysis of financial data on the bargaining subjects at hand. Since the disclosure of financial information may be required in contract negotiations, a planning and management information reporting capability can satisfy certain collective bargaining requirements. This system is also a tool by which the administration can accurately share its economic situation with the faculty and staff. One result of such disclosures may be a greater understanding by all employees of their institution's ability to pay. Through this sharing of financial information, the level of faculty and staff confidence in the administration may increase. It is a foregone conclusion that the overall management of an institution will benefit from the accessibility of information that will enable it to manage more effectively.

Personnel Policies and Procedures

An understanding of the economics of human resources management helps administrators optimize these resources more effectively. If an institution has previously neglected its personnel because of faulty and inequitable personnel practices, collective bargining will quickly resolve such disparate treatment of the employees covered by the agreement. The contract will reduce personnel decisions to written policy statements that are supported by clearly defined procedures for carrying out the policy. These policies provide consistent interpretation, augment the decision making process and insure greater accountability.

The Stanford Project on Academic Governance, conducted by Kemerer and Baldridge, found that ninety percent of all respondents agree with the statement: "Where it occurs, faculty collective bargaining will result in greater specificity of employment rules. Unionization can help protect faculty from inconsistent and vague administrative decisions resulting from external economic pressures...The advantage of bargaining over personnel issues is to establish procedures before crises develop. Administrators as well as faculty may be the beneficiaries of formal personnel procedure."[15]

The cost savings achieved by increased efficiency can be significant. However, while cost savings may be achieved because of consistent policies, one adverse effect of such policy uniformity may be a loss of independent thinking and judgment. If educational institutions become so bureaucratized that their faculty and staff must rely only on a master policy manual to provide the prescribed answers to complex problems, what will become of the problem-solving creativity that has heretofore been one of the hallmarks of higher education? Any decrease in departmental autonomy must be done prudently to prevent the deterioration of the quality of related departmental personnel decisions. Whether higher education can continue to have structured policies and procedures in some areas coexisting with the independence to make creative decisions in other areas remains to be seen.

A potentially negative effect of collective bargaining in academia may be in the tendency to pursue performance review systems that provide measurable, quantifiable objectives. The most logical and possibly the most preferred criteria for performance evaluation is teaching ability. The teaching process, i.e., number of subjects taught, class size, new courses, internships sponsored, surveys developed, and the number of after class hours can be measured with relative ease. But the danger is that teaching may begin to be measured quantitatively rather than qualitatively.[16] An additional problem may be a de-emphasis on research since the quantifiable fruits of research may take decades to grow. The importance of research would, of necessity, be lessened in favor of more measurable criteria. Unfortunately, minimizing the significance of research could lead to a considerable loss of revenues particularly for those institutions that are commonly considered major centers of scholarly research. Further, the potential loss to society is immeasurable.

Tenure

The present economic situation coupled with faculty bargaining may also have a significant effect on tenure. As position vacancies decrease and faculty turnover stablizes, tenure becomes an important negotiable subject. Of course, there are critics who were attacking the question of tenure long before collective bargaining became a major issue on campuses. These critics argue that tenure is not necessary to ensure academic freedom for the faculty and, further that the granting of tenure has an adverse effect on teaching performance because it virtually assures life-long employment. Opponents of the tenure system may conceivably use collective bargaining and its fiscal impact as a way of eliminating tenure. Arguing that tenure is nothing more than an early retirement system for the incompetent and an unaffordable luxury, tenure could be negotiated away or changed by multi-year contracts. What effect this would have on the quality of education and the subsequent cost to the university in terms of meeting society's educational needs will continue to be a hotly debated question.

Compensation

There is conflicting evidence of whether salaries at universities with collective bargaining agreements are higher than salaries at non-union institutions. Regardless of which position one accepts the negotiation of salary issues during this era of high inflation is an extremely difficult and oftentimes, highly emotional issue. During periods of double digit inflation, employees, spurred on by union officials bring to the table a feeling of self-righteousness along with their wage and benefit demands. After listening to a litany of economic problems including interest rates, the high cost of food, fuel, gas, clothing, educational expenses, et al, the management negotiator has the almost impossible task of explaining to the employees his concern and understanding while simultaneously explaining how those identical cost increases have also placed the institution in a difficult financial situation. Obviously, there is no professional or personal satisfaction in negotiating a wage clause which leaves the members of the bargaining unit in a worse economic position than they were before bargaining. The decline of purchasing power promoted by the continuing escalation of inflationary pricing can create this effect even if a generous increase, based on an institution's ability to pay, is granted.

But often because of fiscal implications, there is no alternative. It is a hard but necessary fact. The stressing of significant performance and productivity increases allied with substantial decreases in expenses is not the language unions wish to hear. Nevertheless, if many institutions, especially small ones, expect to stay in business, it is a theme that must be pursued.

In negotiating wage increases, administrators must offer compensation packages that comply with the institution's ability to pay; long-term contracts should be avoided; cost of living increases tied into complex formulas should be denied and increases influenced by measurable performance factors should be sought. Institutions uncertain of their budget status should vigorously defend their right to defer compensation commitments.

In this regard, the NLRB recently ruled that a non-profit educational television station had bargained in good faith when, uncertain of a state appropriation, it refused to offer a wage proposal to union representatives during contract negotiations. The Board held that until the campus T.V. station knew how much money the state legislature would appropriate for salaries, it had no choice but to defer wage proposals. [University of Vermont/Vermont Educational Television and International Brotherhood of Electrical Workers, Local 42, AFL-CIO, 9/24/81.]

Unions, employees, and if necessary, legislators and governing boards may need to be reminded that the wage gains which a union obtains for one employee group usually come at the expense of another employee group. In non-profit institutions, monetary gains do not come from surplus as unions often allege.

Strikes

The adage "When elephants wrestle, it is only the grass that suffers" is quite descriptive of strikes in academe. Students, faculty and staff are more directly affected than administrators or union officials. The strike has historically been the ultimate and most potent source of union strength in bending management to its will.

In 1973 Carr and VanEyck wrote:

> The right to strike is so closely associated with labor's right to organize and bargain collectively, both in law and practice, a spread of faculty bargaining will probably be accompanied by an

> increasing number of faculty strikes. At private colleges and universities the faculty strike will be legal, but it will be waged against an adversary hard to pinpoint and difficult to hurt. At public colleges and universities, the political setting may mean that governing boards will prove somewhat more vulnerable and thus ready to give ground in order to end work stoppage promptly, even though such strikes are unlawful. This is a dubious assumption at best. If the faculty strike does prove to be an ineffective weapon, only time and experience can then show how faculty bargaining will be affected.[17]

Their prophecy was an accurate one: the strike has been used very infrequently in higher education.

As Walton and McKensie point out, the strike costs borne by employees and their organizations include wage losses, effect on the security of the employees organization through loss of membership and financial resources, loss of goodwill with management officials, and damage to the public images of the employee's organization. These losses are not unlike those suffered by management.[18]

Normally every effort should be employed to avert a strike. However, administrators should not reject out of hand taking a strike until they have examined the potential advantages of a strike. Indeed, the permanent replacement of economic strikers, reinforcement of managements rights, or gaining an important contractual concession may be worth the risk associated with a strike.

Arbitration

Arbitration can be defined as a method of settling labor-management disputes by having an impartial third party render a decision which is binding on both the union and the employer. Obviously, disagreements will arise between the parties and a third-party judgment will be required. To the uninitiated, these disputes can have a serious financial impact. Arbitration awards and attorney's fees are quite expensive. In addition, most arbitrators have received their training in the industrial sector, and although their professional principles are above question, the practice of having representatives with relatively little understanding of academia making decisions which will affect it is a doubtful one. Arbitrator's solutions to labor disputes are invariably copies of solutions that work in manufacturing plants or municipalities. Rarely do they work in academia. If possible, arbitration should be avoided.

Decertification

Perhaps the most misunderstood and misrepresented area of collective bargaining is deunionization through decertification. Unfortunately, many administrators are unaware of the processes of decertification and deauthorization. Colleges and universities which are presently organized are in an excellent position to return to their nonunion status. Often all that is required is for employees and administrators to become aware of the legal remedies available to them under the auspices of the NLRB. As unions fail to deliver on promises, more and more of the union membership may become disgruntled and will seek alternatives to organized labor. In 1978 there were 1,754 decertification petitions filed with the NLRB: 807 elections were held; 594 resulted in deunionization.[19]

There are three deunionization processes:

1. The decertification petition
2. The deauthorization petition
3. The employer petition

The decertification petition is a process whereby the employees in the bargaining unit believe that their current union no longer has the support of the employees, and they petition the NLRB for decertification under Section 9 (c) of the National Labor Relations Act.

The deauthorization petition is a process whereby employees in the bargaining unit file a petition with the NLRB during the term of the contract requesting a union deauthorization election to determine if a majority of the employees in the unit wish to cancel the union security clause. If the election is won by the employees requesting the election, the union still continues as the bargaining agent but employees are no longer required to join the union or to pay dues.

The employer petition is a procedure where, under certain conditions, an administrator may file a petition that can lead to the ouster of the union. The petition must be supported by objective considerations supporting the good faith belief that the union has lost its majority status.

There are definite risks and costs involved in the decertification process and because of its complexities, a labor law attorney should be consulted. If faced with the opportunity to pursue deunionization, the prudent administrator may find that the potential benefit of becoming union free may be well worth the expense and risk involved.

Decision Making and Collective Bargaining

Because of the relationship of the parties at the table and afterwards as they attempt to learn to live with a negotiated agreement, calculated decision making will continue to be the sine qua non of administrative survival. Fiscal determinations must be made in an environment that is conducive to making prudent decisions fostering an open exchange of ideas without sacrificing decisiveness. Unfortunately, educational administrators often choose to ignore the difficult questions: decision making at the administrative level is sometimes more accurately described as passing the buck.

Collective bargaining as an adversarial relationship is well established in the industrial sector. This is less so in the collegiate environment with its tradition of shared power within the institution. One can envision management and faculty/staff union organizations lobbying together for funds to improve the institution's overall financial picture and the potential influence of such an alliance. It is evident that administrators know how to use their influence and have become a persuasive force with legislators and other funding sources. Clearly, employees are not attempting to assist in the decline of postsecondary education, and their self-interest and professional commitment to education precludes destructive action. Faculty and staff members are most concerned with the objectives of their institution and what share of its total resources they will receive. How these resources are allocated affects the faculty/staff and their educational programs most directly. Additionally, monies for salaries, benefits and sabbaticals naturally receive priority attention among the faculty and staff. To attempt to exclude the faculty and staff as a financial lobbying partner may, in the long term, impair an institution's ability to obtain revenue.

Summary

It is futile to debate whether collective bargaining belongs in higher education: It is already there. Collective bargaining is a fact of academic life. Administrators should not assume that an uncontrollable fiscal crisis is at hand. Instead they should analyze the situation and do something about it. Many of the financial ramifications of collective bargaining on the campus can be identified and analyzed, and the degree to which they will effect an institution can be forecast in direct proportion to the institution's sophistication and to its ability to deal with change. From an administrative standpoint, it is often assumed that collective bargaining and all of the subsequent changes that may flow from it are negative. Certainly the increased economic costs--higher wages and salaries, more tenure and sooner, increased benefits and the potential cost of arbitration and strikes--must be viewed as negative factors for colleges and universities. However, except for strike and arbitration costs, these costs would have risen without collective bargstrative standpoint, it is often assumed that collective bargaining and all of the subsequent changes that may flow from it are negative. Certainly the increased economic costs--higher wages and salaries, more tenure and sooner, increased benefits and the potential cost of arbitration and strikes--must be viewed as negative factors for colleges and universities. However, except for strike and arbitration costs, these costs would have risen without collective bargaining. Perhaps the severest disadvantages collective bargaining brings to higher education are the hidden, or indirect, administrative and staff personnel costs incurred by a collective bargaining agreement. Nevertheless, many of the potential changes that may occur in institutional administration because of collective bargaining are positive ones. The negative factors are tempered by the positive results of more centralized and careful long-range institutional planning, the benefit to all employees of clearer, more uniform personnel policies and procedures, the use and accessibility of computerized information systems and the addition to the staff of more qualified educational administrators.

Academic collective bargaining was originated from the industrial environment. It seems appropriate that higher education look to the business community for possible alternatives. The "give backs" or "take backs" that were achieved recently by General Motors and the Ford Motor Company should serve as a paradigm for collegiate negotiators. Collective bargaining requires that the parties meet in good faith and attempt to reach an agreement; it does not mean that they must agree or make concessions. There is no obligation to offer resources which are not available. While Boulwarism is not recommended, neither is it necessary for a college or university to give away its resources and financially cripple itself.

These are troubled times; the academy is suffering. However, administrators possessing creativity, courage, initative and the willingness to assume some risk, can use this environment to secure for their institutions, those policies, practices and procedural revisions that may be necessary for the survival of the institution.

> "It must be remembered that there is nothing more difficult to plan, more doubtful of success, nor more dangerous to manage, than the creation of a new system. For the initiator has the emnity of all who would profit by the preservation of the old institution and merely lukewarm defenders in those who would gain by the new ones."[20]
>
> Machiavelli (1513)

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Use of Microcomputers in Physical Plant Operations

By James Simpkins
North Texas State University

The North Texas State University Physical Plant is composed of nearly 300 employees distributed into approximately 20 different work units and is responsible for maintaining a university community of approximately 20,000 members.

The Physical Plant Administration has long been concerned with improvement of the recordkeeping capabilities in the area. When I first came to the Physical Plant in October 1977 there was talk of being able to computerize the central stores inventory records. There had just begun an attempt to type a catalog of the inventory items. However, before that project was very far under way we were able to obtain a surplused I.B.M. 26 Keypunch and shifted to keypunching the inventory records which allowed perpetual updating and sporadic catalog printing. The keypunch operation was definitely considered as a stop gap measure until the inventory could be totally computerized. However, the keypunch operation proved successful enough that it was determined to also utilize the keypunch to record work orders issued and work orders completed. At the end of each month the computing center then sorted and printed these records in 5 different ways.

In the meantime discussion and consideration was still being given to an inventory processing program on the University's central computer. Discussion revealed that the software for an inventory program would cost approximately $10,000 and would still be batch processed at approximate one-week intervals. This was not particularly appealing and action was delayed in that there was also talk of the acquisition of a newer central computer which would allow a great many more on-line terminals.

Due to the many delays and difficulties encountered in the attempts to obtain, what we thought at that time to be the ideal computerized inventory system, we began to consider the use of microcomputer systems. After considerable investigation and comparison of microcomputers it was determined that a microcomputer sold by Radio Shack was the best choice for our purposes. However, there was still much skepticism because of the lack of computer knowledgeable personnel in the Physical Plant and the fact that 3700 items was the largest proven inventory capability on a microcomputer when our inventory consisted of approximately 9000 items.

The decision was made to buy two TRS 80 Model II microcomputers at a cost of $3392 each, two 3 drive expansion units at a cost of $2044 each, and two line printers at a cost of $1724 each. This was the purchase of two complete microcomputer systems at a cost of $7160 per system.

40

Each system consists of a 64 thousand character memory and just under 2 million characters of data storage area distributed on 4 disk drives. Each system comes with a TRS 80 Disk Operating System that can be upgraded by the manufacturing company as improvements are discovered. This disk operating system is a software package that includes several machine language utility programs and a Basic language interpreter. Also included with each system is an operating manual which illustrates usage of the utility programs and the Basic language programming commands. Thus with a supply of floppy disks and some printer paper all the ingredients are present to develop custom operating programs.

Sure enough the day did come in May 1981 when the long awaited computer equipment arrived. The sales representatives hooked up the computer systems, checked them out, and left. I then discovered that I did not even know how to open the disk drive door. Fortunately with a little reading of the operation manual this obstacle was soon overcome. We were also fortunate to obtain the part-time services of a senior computer science student who is quite adept at Basic language program coding. The Basic language programs for our systems were designed totally by Physical Plant Personnel in a manner which would allow transition to computerized recordkeeping with minimum change in existing manual processes. These systems are largely a duplication of the previously existing manual systems with the addition of a few extra steps made possible by the speed and flexibility of the computer. The results are systems which retain the simplicity of manual systems but allow the abundant real time information of computerized systems.

We received the two microcomputer systems in May of 1981 and before the end of August 1981 had written custom software to have both systems completely operational. However, because of the simplicity of the equipment and the ease of altering software it is practical to continue to improve and or change the operation as needed over an indefinite time.

One of the North Texas State University microcomputer systems is devoted primarily to a work information center operation. The work information center serves as the contact point between the Physical Plant and the rest of the campus entities. In this role the work information center receives several hundred work requests each month. Each work request may result in the initiation of individual work orders to one or more shops. For example: a work request to build and paint a table would result in the initiation of an individual work order to the carpenter shop to build the table and an individual work order to the paint shop to paint the table. Each of these work orders would bear an individual unique work order number but would bear a mutual project number.

Each initiated work order is entered into the microcomputer system indicating the project (request) number, work order number, performing craft, work description, location, funding account and initiation date.

During the period of time that the work is being performed on a given work order all material acquisitions for that work order reference its work order number. Thus materials costs are recorded and accumulated as part of the computer file for each given work order.

Upon completion of a given work order the performing craft reports the hours of labor expended and any shop materials used to the work information center. Then the computer file for the work order can be completed by indicating the labor hours, shop materials and a completion date.

Throughout the performance of these few simple tasks information is being compiled for presentation in various report forms. The following are examples of possible reports:

a. Report of outstanding work orders sorted by craft indicating work load in each shop.

b. Report of work completed by each shop.

c. Report of work completed in each building or location.

d. Productivity of each shop based upon comparison of work hours reported to hours available.

e. Report of total costs of any given work order.

f. Report of total cost of any given project.

Of course this is an overly simplified description of a work order processing system that has many other facets and details that cause it to be one of the most desirable tools that we have been fortunate enough to discover. The following list is just a few of the other capabilities that I have not attempted to describe:

a. Capability of self-assigning work order numbers.

b. Capability of self-assigning project numbers.

c. Automated posting of material acquisitions.

d. Automated charging process.

e. Capability of standing work orders.

f. Capability of individual shop operation expense accounting.

g. Capability of indidual shop inventory accounting.

h. Capability of individual equipment cost accounting.

All program arrangements are completely operator oriented to the extent that even I can operate them correctly. The following three illustrations are similar to what the computer screen resembles in the work control program just described.

```
              NTSU PHYSICAL PLANT WORK ORDER CONTROL SYSTEM
                             May 19, 1982

 1  WORK ORDER CONTROL:                  4  END OF PERIOD PROCESSING:
      Initiate work orders                    Reset monthly accumulators
      Complete work orders                    Reset monthly & yearly accumulators
      Access/update files                     Print out End-Of-Period reports
      Project number scroll                   Purge work order data diskettes

 2  TRANSACTION CONTROL:                 5  INTER-DEPARTMENTAL CHARGING:
      Read transaction disk                   Charge work order IDTs
      Correct read errors                     Charge service report IDTs
                                              Charge M&O and Purchasing IDTs
 3  REPORT GENERATION CONTROL:                Charge Interdepartmental Orders
      Report by location
      Report by account number           6  SERVICE REPORT CONTROL
      Report by project number
      Report by craft incomplete         7  UTILITY PROGRAMS

Press the  ESC  key to END program               SELECTION >
```

```
                         ACCESS/UPDATE CONTROL FILES

CONTROL FILES:

 1 - WORK ORDER INFORMATION
 2 - CRAFT INFORMATION
 3 - BUILDING INFORMATION
 4 - ACCOUNT INFORMATION
 5 - EQUIPMENT INFORMATION
 6 - WORK ORDER NUMBER
 7 - PROJECT NUMBER
ESC - EXIT TO MAIN PROGRAM




                              SELECT FILE > .
                         WORK ORDER                No. 45991 / 0999A

To: PAINT

Date: 05/18/82          Location of work: BRUCE HALL

Work to be done: C-300 BATHROOM, 4TH STALL FROM DOOR: REPLACE THE PIPE SPACE COV
ER.

Charge to: 62100 - BRUCE HALL                      Object code: 266
ESTIMATED COST:          $0.00
ACTUAL COSTS:         Labor Cost:          $0.00     Shop Materials:          $0.00
                     Labor Hours:           0.0     Store Materials:          $0.00
                                                  Owner's Materials:          $0.00

          Press  ENTER  to continue or  F1  to search for another
```

The other North Texas State University microcomputer is devoted to our central stores inventory record system. This system has developed into a much more capable system than we had ever anticipated. Yes, we did accomplish getting all 9000 inventory items on line at one time. In fact our capacity is greater than our anticipated need at this time. This system has become much more than just an inventory system. It serves as a tool to develop cost accounting records for all material acquisitions of the Physical Plant. It allows not only record of items stocked but it is the tool for direct charging of all non-stock items as well. Instead of describing this simple operating system with complex capabilities I will simply name the following list of capabilities:

a. Automated cycle count control.

b. Automated stock level check

c. Automated reorder notification based upon 10 different stocking formulas.

d. Weekly purchases recap.

e. Weekly report of outstanding reorder notifications.

e. Capability of stock adjustment and report of shrinkage.

g. Prints its own forms for hard copy reporting of individual items.

h. Capability of on-line status check of any stock item.

i. Automated record of on-order file.

j. This sytem furnishes the automated materials input to the work control program.

These are only a few of the many capabilities and options available on an inventory program that is completely customized to our exact needs.

In addition to these two very neat program systems we have also realized the need and capability of developing independent programs to serve many special tasks that were originally not seen as functions for our microcomputers. Again rather than elaborate upon any individual program I will just list some of the names for your speculation.

a. Vendor Program - a complete listing of all vendors from which the Physical Plant buys materials or services. This list can be organized in many different ways. Ex. by type of materials; by using shop; alphabetically etc.

b. Telephone Program - a complete listing of all university telephone stations organized by department, by building, etc.

c. Personnel Program - a complete listing of all the Physical Plant Personnel indicating salary level, work location, employment date, etc. for presentation in a variety of ways.

d. Budget Program - file system that keeps track of sixteen different accounting areas and can do expenditure projections based upon previous five years of accumulated history.

e. Electricity Program - file system that keeps track of the electricity usage through 52 different meters and can do the billing computation for each. This program shall be developed to do the same type five-year projection as mentioned in the Budget Program.

f. Uniform Program - a program designed to keep track of uniform possession and do billing to the appropriate work area based upon charges from the rental company.

g. Small Tools Program - a program designed to do small tools inventory reporting for all shops.

h. Equipment Program - file system designed to keep up with Physical Plant equipment cost of upkeep etc.

In addition to these fringe programs the success of our microcomputer system has reaped other awards. It has resulted in additional assignment of responsibility for the Physical Plant.

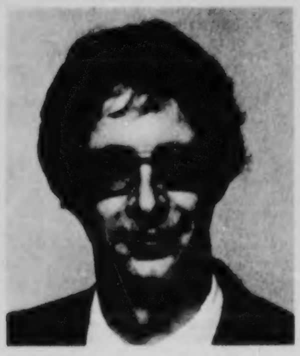
The Physical Plant has received the assignment of establishing a key control system for the University which had formally been a responsibility of the Security department. This additional responsibility has justified the need for some additional equipment in that storage capacity and on line keyboard time was surpassed with this new requirement. An additional TRS 80 Microcomputer has been ordered and received and an order has been placed for a hard disk storage system to supplement the existing equipment.

The addition of this new equipment shall allow the establishment of a very efficient key control system.

The addition of the hard disk shall also allow operation as a network of systems with a common data base. This will result in an overall savings of storage space and increase the speed of processing for all systems.

The addition of microcomputers to an organization that has not been accustomed to them is perhaps somewhat dangerous in that there seems to be no stopping point. For each thing that one does with the microcomputer there always seems to be at least two more that it is desirable to do. Therefore, I believe that we will continue to desire to expand into additional areas such as Preventative Maintenance records and scheduling, front office time keeping, printing of our forms, and word processing. I believe the microcomputer is here to stay and will soon be just as prevalent as the typewriter.

Energy Management



Saving Energy in 100% Outside Air Units

Joe Dale Ball, PE, CEM
The University of Texas
Health Science Center at San Antonio

Universities and colleges have many areas that require comfortable space conditions, but also require one hundred percent outside air. Operation of the one hundred percent outside air units has the highest energy cost per square foot and is the most difficult to optimize. Yet efforts expended in the direction of optimizing the operation of these units will pay large dividends.

At the University of Texas Health Science Center at San Antonio, 800,000 CFM of outside air is utilized. If a system were installed that would reduce the amount of energy expended in conditioning this air by 1 BTU/lb. of dry air, an annual savings of $200,000 would be realized.

When optimizing the operation of this type of air conditioning system, some of the conventional energy-saving methods are not applicable and others are ineffective. To counter this, a new approach must be taken, one aimed at cost avoidance rather than load reduction.

In many cases, a one hundred percent outside air unit will serve laboratories, offices and animal quarters. Examining the air conditioning requirements of these areas indicates that the laboratories and offices require air conditioning only during working hours, but the animal quarters require air conditioning twenty-four hours per day. In many instances the unit is operated to handle the worst case condition, causing excessive energy usage. One solution is to install dampers in the duct work leading to the laboratory and office areas and install devices to control the exhaust from these areas (Figure 1). This will reduce the effective size of the air conditioning system and result in substantial savings.

Assume there is a 100,000 CFM, 100% outside air, constant volume double duct system in San Antonio, Texas, with 50,000 CFM serving offices and laboratories, and 50,000 CFM serving animal quarters. Using the BIN method, a savings in thermal energy of 7800 MM BTU/yr. is achieved by reducing the system size during non-working hours. Actual field measurements indicate the motor horsepower was reduced by thirty percent, resulting in an electrical savings of 63,000 KWH/yr.

In some cases, the special temperature and humidity needs of a small area can dictate the operation of a large air conditioning unit. Rather than allowing this to occur, the installation of auxiliary equipment such as a DX coil for lower than normal temperatures, or an electric heating coil for higher than normal temperatures in the duct work leading to the specific area might be more economical. These auxiliary devices will allow fine control of temperature and humidity over a wide range of supply air conditions and provide a more economical system operation.

But, some imaginative thinking is still required. In conventional applications, DX units are cycled in an attempt to maintain space conditions. The large variations in temperature and humidity as a result of this type of control are unacceptable in many applications. One method that will produce constant space conditions is to allow the compressor to run continuously and install two condenser coils piped in series. One condenser coil will be mounted in the duct work downstream of the evaporator with face and bypass dampers around it. The other condenser coil will be mounted external to the duct work with a condenser fan (Figure 2). The evaporator will cool the air to the desired moisture level, and the face and bypass dampers will modulate air around the condenser coil mounted in the duct work, thus providing any required reheat. The condenser coil mounted external to the duct work will reject the heat not required by the process.

This system could maintain very specific environment conditions in a small room requiring 100% outside air for about $2.00 per day.

During the pre-energy awareness period, the surest method of maintaining space comfort was to pre-cool all the air going through an air handler and then reheat a portion to produce a hot deck. This system produces wonderful space conditions but uses a tremendous amount of energy to accomplish it (Figure 3). With this in mind, one of the air conditioning units configured in this manner was rebuilt as a conventional double duct unit with a separate cooling coil in the hot deck to control humidity when needed (Figure 4).

Using the BIN method and taking into account the hours per day that this air handler operates, it was estimated that this change would save 900 MM BTU/yr. for this 35,000 CFM unit. In practice it was found that because of conditions in the building, the pre-cooling coil in the hot deck did not have to be used, producing additional savings.

These are specific items that service a particular area, but sometimes looking at the energy needs of the entire complex can produce an energy conservation opportunity. In so doing it was noted that during periods of low temperatures, the air entering the one hundred percent outside air units is pre-heated to 50°F. and then channeled to a cold deck and hot deck or to a reheat coil, for final tempering. It was also noticed that during the same periods, the return air type air conditioning units serving the classroom and office areas were on the economizer cycle providing free cooling but very expensive heating. With these facts, it was a small step to examine the possibility of using the chilled water system as a run-around heat exchanger. This would provide a means of capturing the heat normally rejected from the building and using it to pre-heat the air entering the one hundred percent outside air units.

The system utilizes the cooling coils of the return air type units as the heat source and the pre-cool coils of the outside air units as the heat rejection side (Figure 5). Properly designed and controlled, this system achieves a balance point furnishing free cooling to the cold decks and free heating in the pretreat units.

Disregarding piping heat losses and other small heat losses, the governing equation for the system is:

$$Q \text{ in} - Q \text{ out} = Q \text{ stored}$$

Q in - heat absorbed by the cold deck coils
Q out - heat rejected in the pretreatment units
Q stored - heat stored in the chilled water which will cause a temperature change

Expanding these terms:

$$Q \text{ in BTU/HR} = \text{CFM} \cdot 60 \text{ min/hr} \cdot \text{Cp BTU/lb}^\circ\text{F} \cdot \text{D lb/ft}^3 \cdot \Delta T \cdot \text{Coil Eff}$$

$$Q \text{ out BTU/HR} = \text{CFM} \cdot 60 \text{ min/hr} \cdot \text{Cp BTU/lb}^\circ\text{F} \cdot \text{D lb/ft}^3 \cdot \Delta T \cdot \text{Coil Eff}$$

CFM = Air volume across the coil
Cp = Specific heat at constant pressure BTU/lb°F
D = Density lb/ft^3
ΔT = Temperature difference, absolute value of incoming air temperature - chilled water supply temperature
Coil Eff = Correction factor for the heat transfer capability of the coil. Chilled Water Supply Temp/Discharge air temp.

These expressions can then be inserted into the governing equation to calculate the heat that is stored in the chilled water. This heat will change the chilled water supply temperature defined by:

$$\text{CHWS}_1 = \text{CHWS}_2 + [Q \text{ stored}/(\#H_2O \cdot \text{Cp})]$$

CHWS_1 = New chilled water supply temperature
CHWS_2 = Old chilled water supply temperature
$\#H_2O$ = lbs of water in the system
Cp = Specific heat of water

The chilled water supply temperature is then inserted back into the governing equations on the next iteration.

These equations were used as the body of a computer simulation program so that the actual operation and feasibility of the system could be determined. The simulation showed that under steady state conditions, if the system is properly designed, the heat into the system and the heat out of the system will converge. The simulation also showed the steady-state chilled water supply temperature. This was needed to determine whether sufficient preheating was available at that outside air temperature. Figure 6 shows the results of the 35°F to 30°F outside air temperature change.

Combining the results of the computer simulation with the BIN data for San Antonio, the projected savings was calculated. The total savings is the sum of the heat saved at the preheat coils and the heat saved at the hot decks by not having to use outside air for cooling, minus the energy used to operate the chilled water pump. Tabulating this resulted in the following table, which describes yearly savings:

Q preheat - Q_{50}	=	540 MMBTU
Q_{40}	=	1854 MMBTU
Q_{30}	=	662 MMBTU
		3056 MMBTU
Hot Deck Savings		4430 MMBTU
Total Heat Saved		7486 MMBTU
Pumping Energy-125 hp		186 MMBTU
Actual Savings		7300 MMBTU

For best results, the heat exchange cycle should be controlled and monitored by a building automation system. Any computer based system on the market should be able to handle the interlock and monitoring requirements of this control scheme.

The monitoring and control points required are:

1. Pretreatment discharge temperature of each pretreatment unit involved.

2. Cold deck temperature of the return air units.

3. Chilled water supply temperature for the pumping system.

4. A start/stop/status point to override the local controls at the pretreatment unit. This device will cause the pre-heat valve to close and the pre-cool valve to open.

5. Start/stop/status points to energize and de-energize the economizer cycles of the return air type units involved in the sequence.

6. A start/stop/status point to open and close valves to isolate the pumping system from the mechanical cooling.

7. A start/stop/status point for the chilled water pump to be used with the sequence.

8. An outside air temperature sensor.

Most of these points are currently available in most building automation systems.

As the outside air temperature drops to the level at which the heat exchange process becomes economical, the computer will position all of the valves required to isolate the chilled water pumping system. The chilled water pump is then started. The status feed-back for the chilled water pump should be a flow switch to ensure that water is actually flowing.

Once water flow has been proven, the cold deck high limit, and the chilled water supply temperature should be compared. If the chilled water supply temperature is higher than the cold deck high limit, the pretreatment unit controls should be started first. If the chilled water supply temperature is less than the cold deck high limit, the economizer cycles should be de-energized first. When the chilled water supply temperature reaches a point below the cold deck high limit, but above the pretreatment discharge low limit, the remaining units can be energized.

As the heat exchange scheme operates, the building automation system should continuously monitor the chilled water pump status, the cold deck temperatures, the pretreatment discharge temperatures, and the chilled water supply temperature. If the chilled water stops flowing, all units should immediately return to local control. If any cold deck should rise above its high limit, its associated economizer should be energized. This will reduce the heat input to the heat exchange circuit. If any pretreatment discharge should fall below its respective low limit, it should be de-energized. Loss of flow and exceeding limits represent system faults; if either should occur, the local controls and the limits should be checked, and when the fault is corrected the units manually reconnected.

The main controlling element is the chilled water supply temperature. As this temperature rises and falls, it is a direct indication of the degree of imbalance between the Q in and Q out sides of the system. The chilled water supply temperature should have a series of high and low limits. As each of the high limits is reached, one stage of the Q in section should be de-energized (economizer turned on). As the water temperature returns to normal the Q in sections should be re-energized. Conversely, as the water temperature falls below each low limit, one stage of the Q out section (pretreatment unit) should be de-energized.

This control will cause the system to automatically seek the point at which Q in will equal Q out. As outside air temperatures and building loads change, the building automation system will energize or de-energize as required to maintain a balance.

There is a point at which all of the Q in sections, or all of the Q out sections will be de-energized. At our institution, if the Q out sections are de-energized, the pump continues to operate supplying chilled water to the cold decks to handle the small loads. As the water temperature rises, a section of the Q out will be energized to cool the water. If the Q in sections are de-energized, an outside air temperature too high for the control scheme to be effective is indicated. At this time the pretreatment units are returned to local control, and the mechanical cooling is energized. Figure 7 illustrates this control sequence.

A serious energy conservation program should be far past the lower the hot water temperature and relamp stages. Each university should be at a point where it is searching for those elusive BTU's, a point where every new project is installed to operate as efficiently as possible. The cost avoidance approach to energy conservation helps in making new project decisions; and the cost avoidance approach, teamed with imaginative thinking, can produce outstanding energy conservation opportunities in our existing systems.

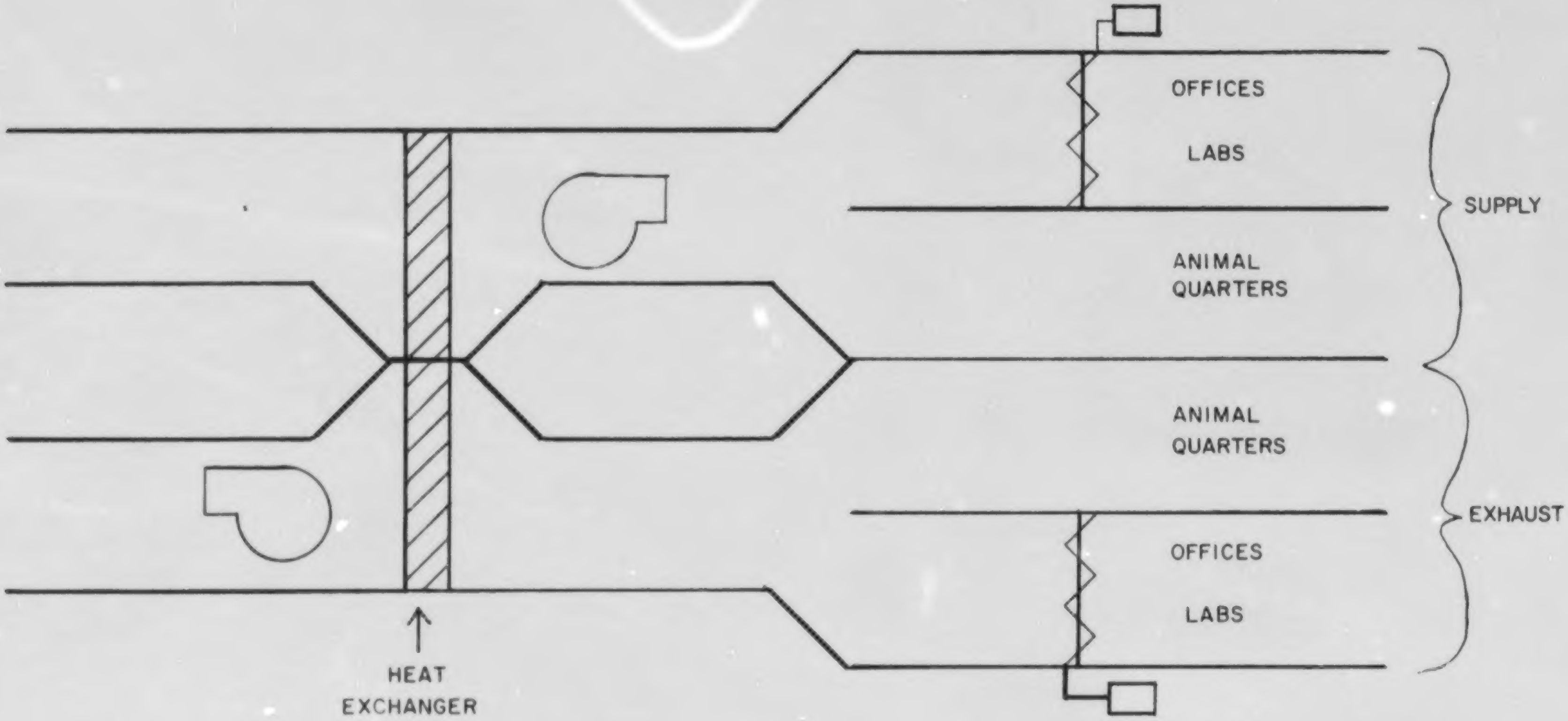

OFFICES
LABS
SUPPLY
ANIMAL QUARTERS
ANIMAL QUARTERS
EXHAUST
OFFICES
LABS
HEAT EXCHANGER

FIG. 1 SEPARATION OF AREAS BY TIMING REQUIREMENTS

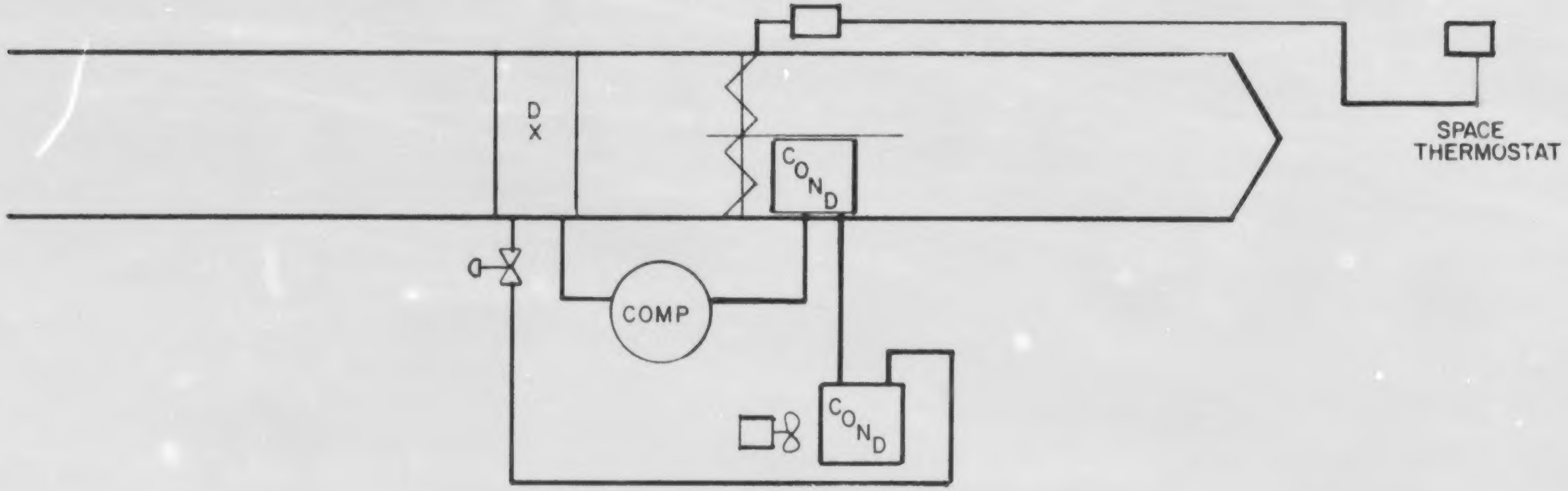

D
X
CONDENSER
COMP
COND
SPACE THERMOSTAT

FIG. 2 DX COIL WITH CONDENSER REHEAT

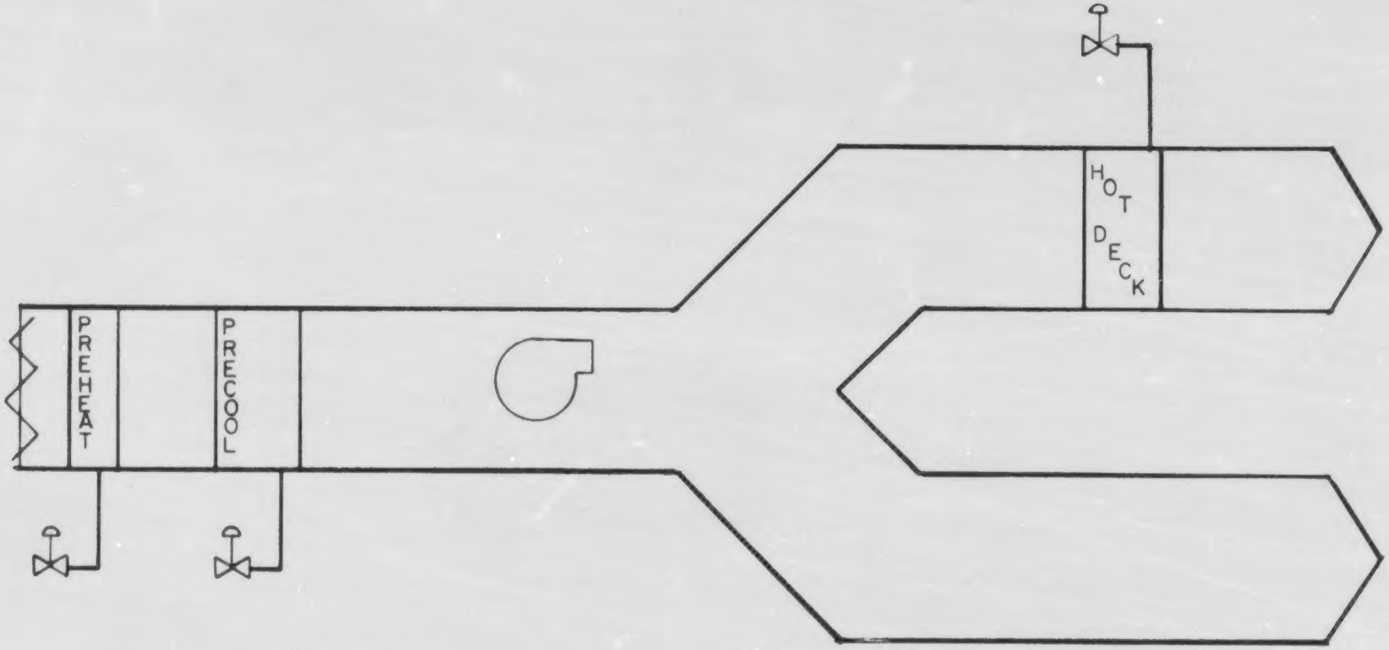

PREHEAT
PRECOOL
HOT DECK

FIG. 3 CONVENTIONAL AIR UNIT WITH REHEAT FOR HOT DECK

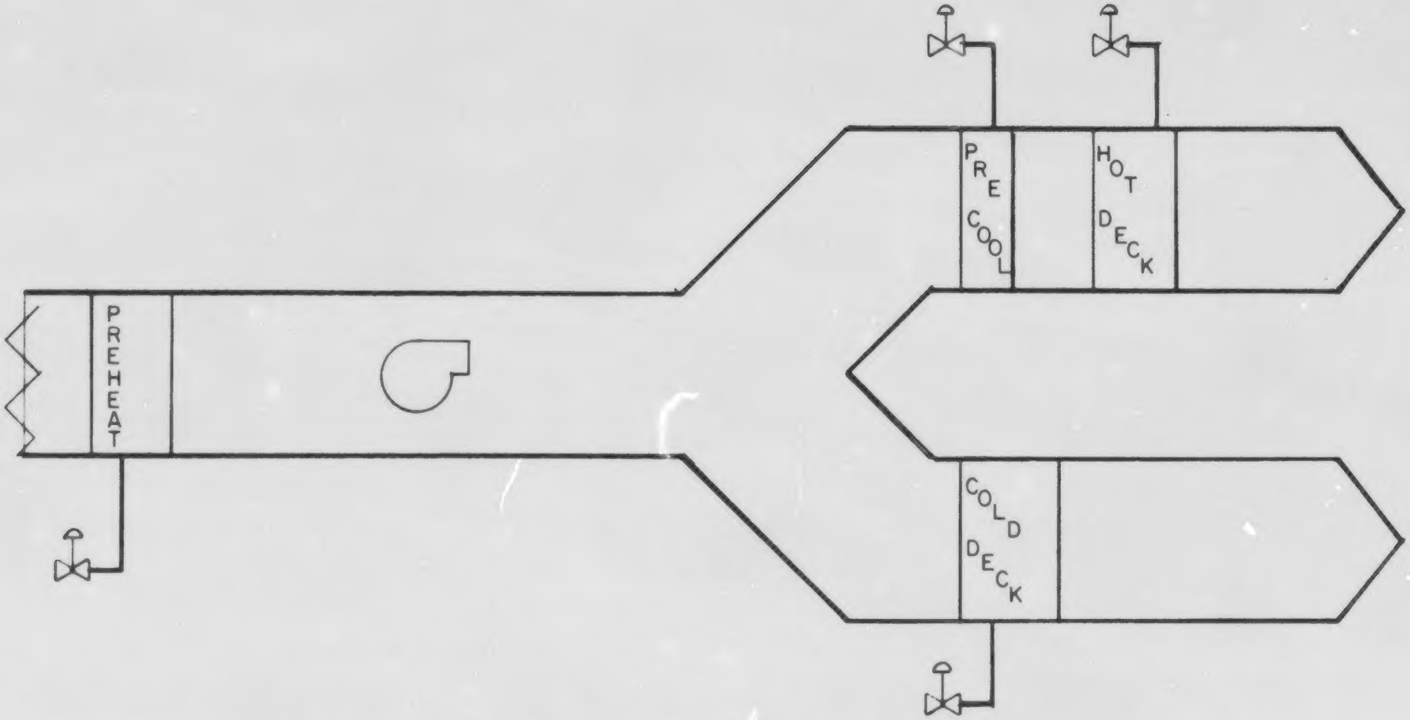

PREHEAT
PRE COOL
HOT DECK
COLD DECK

FIG. 4 REBUILT TO DOUBLE DUCT

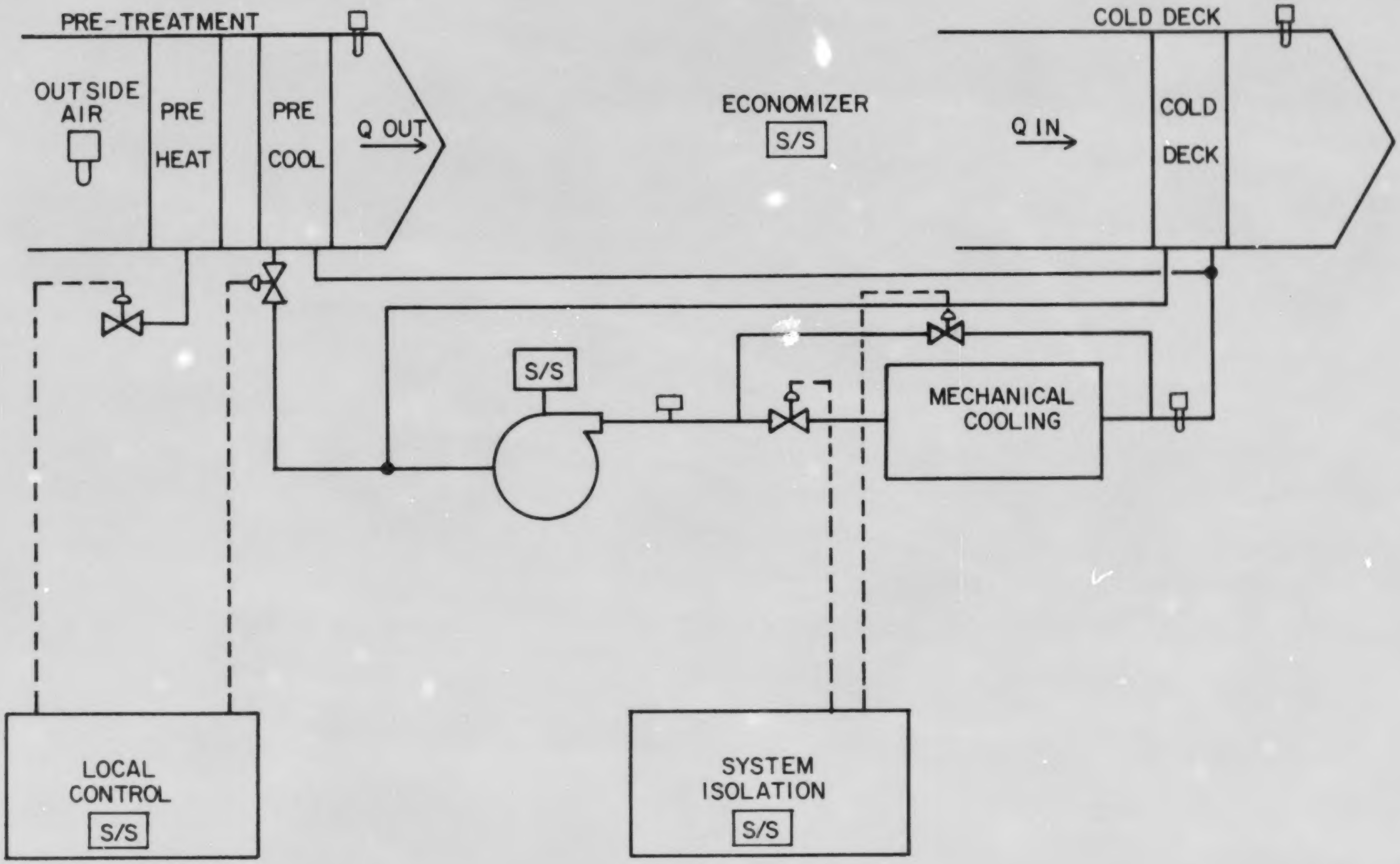

PRE-TREATMENT
OUTSIDE AIR
PRE HEAT
PRE COOL
Q OUT
ECONOMIZER
S/S
COLD DECK
Q IN
COLD DECK
S/S
MECHANICAL COOLING
LOCAL CONTROL
S/S
SYSTEM ISOLATION
S/S

FIG. 5 SCHEMATIC OF RUN-AROUND HEAT EXCHANGE SYSTEM

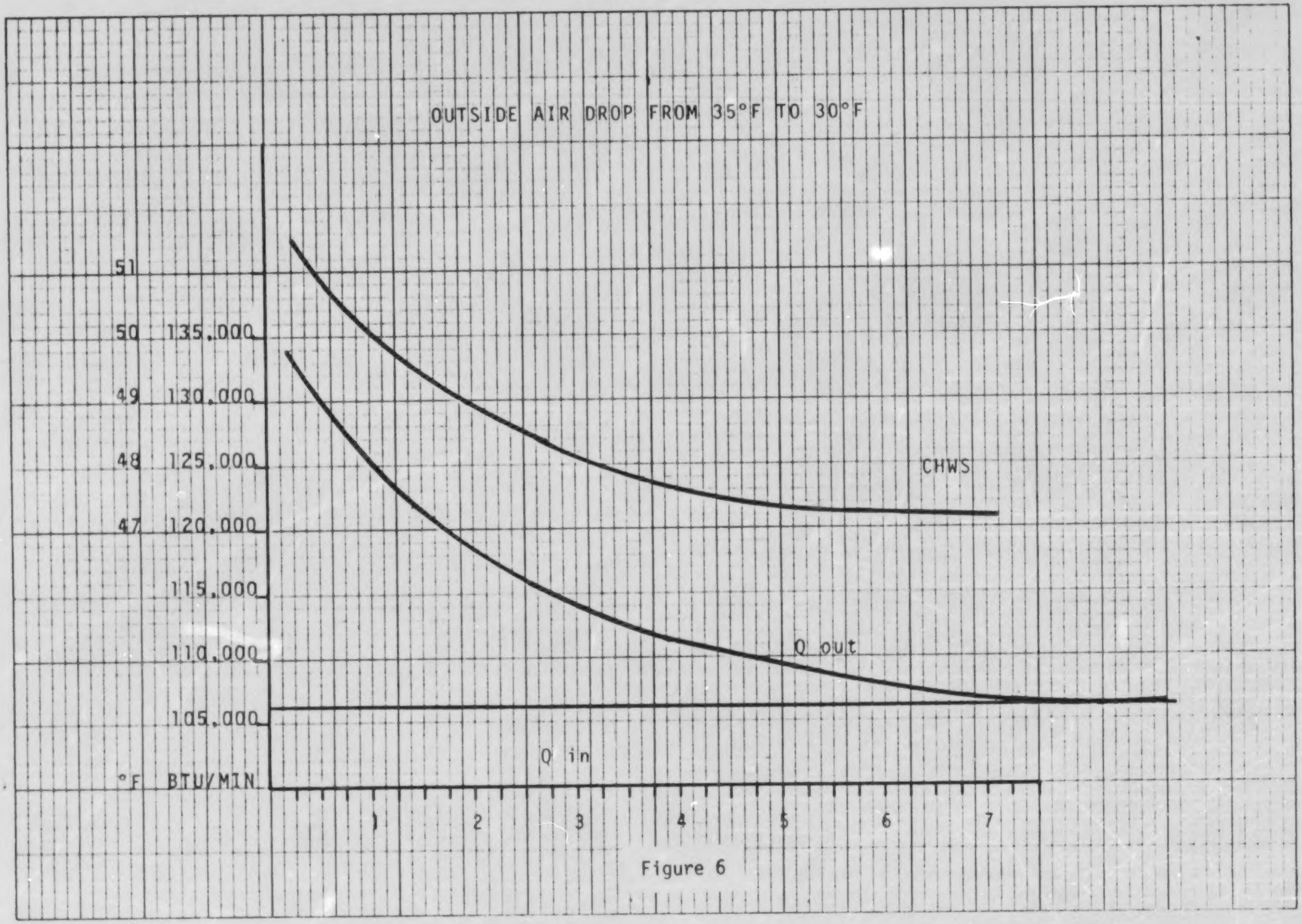

OUTSIDE AIR DROP FROM 35°F TO 30°F
51
50
49
48
47
135,000
130,000
125,000
120,000
115,000
110,000
105,000
°F
BTU/MIN
CHWS
Q out
Q in
1
2
3
4
5
6
7

Figure 6

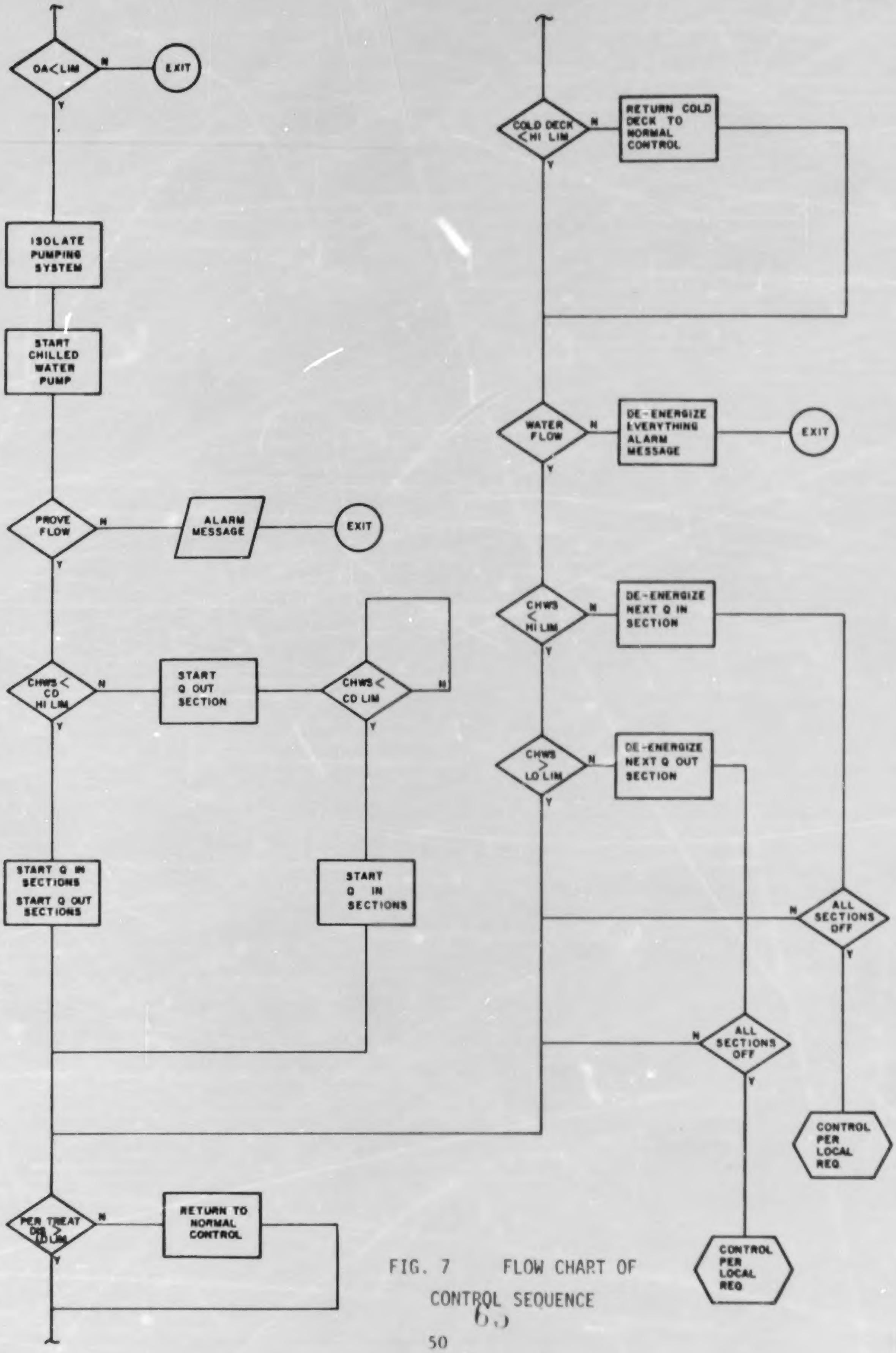

OA<LIM
N
EXIT
Y
ISOLATE PUMPING SYSTEM
START CHILLED WATER PUMP
PROVE FLOW
N
ALARM MESSAGE
EXIT
Y
CHWS < CD HI LIM
N
START Q OUT SECTION
CHWS < CD LIM
N
Y
Y
START Q IN SECTIONS START Q OUT SECTIONS
START Q IN SECTIONS
PER TREAT DIS > LO LIM
N
RETURN TO NORMAL CONTROL
Y
COLD DECK < HI LIM
N
RETURN COLD DECK TO NORMAL CONTROL
Y
WATER FLOW
N
DE-ENERGIZE EVERYTHING ALARM MESSAGE
EXIT
Y
CHWS < HI LIM
N
DE-ENERGIZE NEXT Q IN SECTION
Y
CHWS > LO LIM
N
DE-ENERGIZE NEXT Q OUT SECTION
Y
ALL SECTIONS OFF
N
Y
CONTROL PER LOCAL REQ
ALL SECTIONS OFF
N
Y
CONTROL PER LOCAL REQ

FIG. 7 FLOW CHART OF CONTROL SEQUENCE

Retrofit Lighting - A Presentation of Successes at Gallaudet College

By Jim Hull

Presented by Ronald M. Eng, P.E.
Gallaudet College

$89.16 per kilowatt per year is a pretty impressive power demand figure - it is the norm for large commercial users in the District of Columbia because of the time-of-day billing rates. Depending on your local utility, voltages supplied and rates charged, your cost may be more or less.

Each lighting fixture --- each lamp contributes to the demand and consumption of power whether it is efficient or not. We know we cannot produce goods or services without light. We can, however, control the cost of light. We can maintain needed illumination with better quality lighting and at lesser costs. Keep in mind the key to economical use of light is the word needed.

Once need has been established, the following retrofit methods may be chosen as alternatives to the existing or complete installation of a new lighting system.

Retrofit of High Intensity Discharge Lamps in Existing Fixtures & Ballasts, High Pressure Sodium or Multi-Vapor

One very economical way to accomplish low-cost improvements in high intensity discharge (H.I.D.) lighting is the direct substitution of lamps in existing fixtures using the existing ballasts. For example a 360W high pressure sodium lamp may be substituted for a 400W mercury vapor lamp - and you pick up approximately double the amount of illumination while reducing the fixture wattage. The end result is a possible reduction of half of the fixtures in use, depending on spacing, light patterns, etc.

The cost difference between mercury and high pressure sodium may be minimized by your savings in power consumption per lamp.

Retrofit of Existing Fixtures with Reduced Wattage Ballasts Sized and Rated for Standard High Intensity Lamps, High Pressure Sodium or Multi-Vapor

At Gallaudet College we have successfully changed the ballast and starters in all the fixtures in our boiler and chiller room to utilize high pressure sodium instead of the mercury units. The change resulted in reducing our lighting load by over 50% and increased our illumination level by 10%.

This also permitted the use of standard wattage H.P.S. lamps which are priced somewhat below the retrofit H.P.S. lamps. Secondly, the rated life is 65% longer, requiring less lamp changes over the years.

Direct Substitution of Long Life or Reduced Wattage (Energy Savings) Incandescent Lamps for Standard "Off-the-Shelf" Lamps

There are a number of long life incandescent lamps on the market in both reduced and standard wattages with corresponding differences in cost. These range from a 2500 hour life lamps at nominal cost by the big three manufacturers to 20,000 hour lamp at elevated costs by another manufacturer. These long life lamps will reduce your lamp change labor costs. Caution: Before making a decision on their use check the specifications. One well-known brand of a 50 ER-30 (eliptical reflector) 2000 hour lamp at $1.91 produces 105% more lumens of light than a 20,000 hour lamp at $11.85 cost. You may not be able to afford the loss of illumination.

An alternative to long life incandescent lamps is the reduced wattage so-called watt-miser lamps saving about 15% of the wattage for a like amount of illumination. Such reductions would substitute a 52 to 54 watt lamp for a standard 60 watt, a 67 watt for a 75 watt, etc. After a few weeks accumulation of dust, the difference in illumination is indiscernable.

Do you have a problem with incandescent study lamps? Try using a 50R20 (50W inside frost reflector) in place of a standard 75 or 100W bulb. They burn cooler and get the light where its needed, and have double the rated life.

Retrofit of Incandescent Fixtures with Fluorescent Screw-in or Adaptors

There are a number of manufacturers of incandescent to fluorescent direct conversion lamps and lamp/fixture combinations that will simply screw into a 120 volt socket. Manufactured by these same companies are retrofit fluorescent units to fit in existing enclosed fixtures. This method is an easy fix and usually use circular fluorescent lamps, and good where aesthetics are a consideration. There are cautions in accepting these units at face value, such as:

(1) Vandalism
(2) Theft
(3) Initial Cost - $30 to $50/fixture vs. $25 to $30/fixture for standard single tube fluorescent fixture.
(4) Lamp Life - approximately 4.00 each for a circular lamps vs. $.65 for the 34W standard 4 ft. tube.
(5) Light Output - for a 32W circline lamp, cool-white - 1900

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initial lumens vs. 3050 initial lumens for the 34W standard 4 ft. tube.

Substituting a 20W fluorescent circline lamp for a 75W incandescent of approximately the same light output with energy at 6¢ per KWH will save you 3¢ per eight-hour burn. Also a single lamp change at $2.00 labor per change will save three lamp changes/year or $6, based on current use of the drug store quality of incandescent lamps and a standard 40-hour burn per week.

Not to be overlooked is the substitution of fluorescent screw-in units for incandescent single wattage or 3-way bulbs in table lamps. We have successfully replaced 3-way lamps with G.E. circline units in our dormitory lounges. This unit uses 44 watts and lasts up to 10 times as long as standard incandescent. Bonus #1 - the students cannot turn it up to 150 or 200 watt level. Bonus #2 - it produces about the illumination level of a 150W incandescent bulb, but distributes the light more effectively. Bonus #3 - students don't steal the unit to put in their study lamp because they won't fit.

Retrofit of Existing Fluorescent Fixtures with Improved Lower Wattage Tubes

At Gallaudet we have retrofitted all standard 48" fixtures with energy-saving 34W watt-miser II tubes on an attrition basis. We refuse to stock standard 40 watt tubes except for a few warm white for use over the food-serving lines.

The illumination level of these lamps (and the competition) is for all practical purposes the same as the 40 watt standard lamp. Our cost of these 34W tubes is 25% less than the standard cool white tube.

Another retrofit method where the quantity of light is not needed is the substitution of one lamp in a two lamp circuit with a Sylvanie Thrift-Mate 33 or 50 lamp. This simple substitution reduces the light load by 33 or 50% respectively with corresponding reduction in the light level.

For your information - generally speaking, a standard "cool white" fluorescent tube provides approximately 5% more lumens than the "warm white".

If you are contemplating renovation of space that includes lighting, beware of using the 2'X2' fluorescent fixture using 40W "U" shaped tubes. The produce about 10% less light and cost approximately 280% more per unit, and have approximately 10,000 burning hours less life.

Control of Fluorescent Light to Economize in Quantity Required While Improving Visibility

Fluorescent lighting can be controlled from existing fixtures to provide lighting where it is needed with considerable improvement in quality in addition to substantial savings. This may be done by simply changing the diffuser from standard stock to an engineered diffuser that spreads the light, particularly adaptable to "lay-in" fixtures. These diffusers are available from commerical manufacturers.

This retrofit often will permit the removal of the two outboard tubes in a four tube fixture and maintain a better foot candle level of illumination between fixtures at the work plane since the diffuser is engineered to direct more light outward. Also the diffusers are made of virgin clear acrylic rather than reground trimmed acrylic from other products as in the normal stock diffuser. They are also heavier and less sussceptible to discoloring and splitting than the reground stock.

Another simple conversion is the substitution of polarized lens for the stock lens, again commercially available. Use of polarized lens (diffuser) permits reduction in the illumination level with improved visibility by eliminating veiling glare to a large extent. (This is the glare experienced when reading print on a glossy surface under an incandescent light source.) The appearance of the room under polarized panels appears somewhat dim compared to a "standard" lit room, but the elimination of glare permits much better visibility on the task. The question is - why provide more light then needed to perform the task?

Through the use of polarized lens we have discovered an additional bonus. In a number of cases complaints of severe headaches have become non-existant where we have converted fixtures in the areas where the complainant works to polarized light. From this experience we draw the conclusion that the headaches were caused by excessive glare.

Control of light in retrofit is just as important as the source of the light, and more important - can lead to savings beyond the simple substitution of lamp wattages and types. As an example, a conference room having 165 foot candles of illumination on the table surface was reduced to 70 FC using polarized lens. One of five four tube fixtures was removed completely and two tubes and one ballast removed from the remaining four. The only aspect of the change that bothered conferees was the soft view of the ceiling after being used to the harshness of its prior lighting. Like switching from mercury vapor street lights to high pressure sodium - it takes a little "getting-used-to" although visibility is improved.

Our Experience at Gallaudet

Perserverance in presenting the facts - quality, and cost of owning and operating - of needed illumination has resulted in the use of high pressure sodium lighting in our New Field House, in new parking structures and in grounds lighting. We will be converting one indoor pool from incandescent to high pressure sodium.

A second pool and gymnasium has been retrofitted with high pressure sodium lamps in half of the existing 400W mercury vapor fixtures, the other half being discarded.

We have learned some important lessons at Gallaudet:

(1) Retrofitting a lighting system can be infinitely more expensive than installing efficient lighting at time of construction.

(2) Power cost avoidance by installing efficient lighting at time of construction pays off the cost of installation differential in a relatively short time.

(3) Retrofit, after careful analysis and application, does provide highly satisfactory returns.

How do you make these changes? There is a time when we must "bite the bullet" and say "no!" to existing practices. One must have enough larceny in his heart to steal a little from this or that budget to get the initial quantity of changes purchased and installed. Since the organization will have to purchase replacements, they are simply the new product instead of the old. This replacement is relatively painless. You may want to look at the problem this way - "Behold the turtle - he makes no progress unless he sticks out his head".

Satisfaction? Sure, there are those who are reluctant to change. Other than some adjustments here and there to solve a glare problem, I have heard no real dissatisfaction with the changes we have made over the past several years. It takes a lot of selling, a lot of patience and presentation of the economic facts to the disbelievers. Cooperation, once the facts are known, has been outstanding.

You are limited in retrofit lighting only to the type and sizes of lamps available--and your creative thinking.

A chart of retrofit lamps and several examples of using retrofit lamps are presented for your information. Light sources - technology, phosphors, adaptability - are constantly being improved and with the improvements additional cost saving opportunities surface. Continue to question the existing- with a view towards improvement.

General Sources of Information for Retrofit Lighting Units:

Local Distributors of Lamps: General Electric
Westinghouse
Sylvania
Norelco

Distributors & Manufacturers of Incandescent to Fluorescent Conversion Fixtures:

Energy Conservation Systems, Inc.
3832 S. Four Mile Run Dirve
Arlington, Virginia 22206

Conserve Energy Lighting Produce, Inc.
2626 Lacy Street
Los Angeles, California 90031

Hetherington Industries, Inc.
1610-D Manning Blvd.
Levittown, Pennsylvania 19057

EXAMPLES OF SIMPLE RETROFIT LAMPING SAVINGS

(1) Parking Deck - 2 levels only

Removed 34 175W mercury vapor lamps in entirety.
Removed 27 250W mercury vapor lamps in entirety.
Installed retrofit 215W high pressure sodium lamps in 28 remaining fixtures - no ballast changes.

Net dollar savings 1st year - $1,629 (after installation costs of $759). Before installation estimate was a net loss of $70 in first year (after estimated installation costs of $1,679).

KWH/Year Reduction - 34,142

Intangible Plus: Much better vision than prior alteration.

(2) Swimming Pool - Gymnasium -

Remove 54 of 108 400-watt mercury vapor fixtures in entirety and retrofit remaining fixtures with 360 watt high pressure sodium lamps.

Net dollar savings 1st year - $334 (after installation cost of $3,078)

KWH/Year Saved - 52,380

Estimated 15 year life cycle savings in 1981 dollars - $51,180; in real dollars at 8% inflation - $89,557.

OR

If we went to 325W multi-vapor in lieu of 360W high pressure sodium, we would have to retain 70% of the fixtures to maintain same illumination level - save only 42, 120 KWH/yr., have a net loss of $1108 the first year. Life cylce savings in 1981 dollars of $33,360 or $57,026 in real dollars.

Intangible gain with high pressure sodium is a "sunshine" atmosphere rather than the cool blue - a real morale lifter!

(3) Boiler & Chiller Rooms

This project retrofitted existing fixtures with new ballasts and standard high pressure sodium lamps, and added local switching so four of the six rows of lamps could be turned out when not needed.

Fifteen fixtures converted from 400W mercury vapor to 200W high pressure sodium, five fixtures from 400W mercury vapor to 100W high pressure sodium, and eight fixtures (full time lighting) from 250W mercury vapor to 150W high pressure sodium.

Estimated 70,672 KWH hrs./yr. saved. Installation cost in this case was 9,570 due to contracting the installation to an outside firm - still it is a 2.3 year simple payback.

If work would have been in-house, installation costs would have been approximately 1/3 and payback would have been about one year.

(4) Phantom Tube Installation -

287 fixtures using 18 tubes each are being retrofitted with nine phantom tubes each - reducing lighting level by about 50% and still maintain an average of 60-70 foot candle illumination.

Fixtures are one of a kind item, weigh about 700 pounds each and must be disassembled in place to disconnect ballasts. Disconnecting ballasts would give an unsightly, uneven light distribution on the diffuser.

When project is completed, we will have spent $19,804 in labor and material and have a net gain of $10,746 in the first year.

Saved - 735,956 KWH in power/yr.
Lost - 8,844 gallons in oil to make up heat loss.

Simple payback - .6 year.

RETROFIT HIGH INTENSITY LAMPING

THIS HIGH PRESSURE SODIUM	REPLACES MERCURY VAPOR	H.P.S. LAMP DESIGNATION	MANUFACTURER & RESTRICTION
150W	175W	LUH 150/EZ (Clear) LUH 150/D/EZ (Diffuser)	G.E. - Use only with H-39-175W lag type ballasts, or 240V/277V reactor ballasts.
		LU 150-H (Clear) LU 150-H/O (Diffused)	Norelco - direct replacement in existing fixtures using lag type transformer ballasts or 240V/277V reactor ballasts.
		ULX-150 Unalux	Sylvania - restrictions as above.
Life - 12,000 hrs. 10 yrs./start	Life - 24,000 hrs. 10 hrs./start	C150S63/EL	Westinghouse - Restrictions as above.
215W	250W	LUH 215/EX (Clear)	G.E. - use only with H37-250W lag type ballasts or 240V or 277V reactor ballasts.
		LU 215-H (Clear) LU 215-H/D (Diffused)	Norelco - restrictions as above.
		ULX-215 Unalux	Sylvania - restrictions as above.
Life - 12,000 hrs.	Life - 24,000 hrs.		Westinghouse - restrictions as above.
360W	400W	LUH 360-H (Clear) LUH 360-H/D (Diffused)	Norelco - restrictions as above.
Life - 16,000 hrs.	Life - 24,000 hrs.	ULX 360 Unilux	Sylvania - restrictions as above.
*325W	400W	MRV 325/1/U/WM	G.E. - operation only on single lamp 400W CW or CWA mercury ballasts

800W Life - 12,000 hrs.	1000W Life - 24,000 hrs.	ULX 880 Unilux	Sylvania - use on 480V reactor ballast only.

Note: 150W HPS retrofit clear lamp produces 12,000 lumens vs. 8,200 lumens for a clear 175W mercury vapor lamp. Mean lumen increase 66%.

215W HPS retrofit clear lamp produces 20,000 lumens vs. 12,500 lumens for a 250W clear mercury vapor lamp. Mean lumen increase 66%.

360W HPS retrofit clear lamp produces 38,000 lumens vs. 21,500 lumens for a 400W clear mercury vapor lamp. Mean lumen increase 66%.

*This lamp is a multi-vapor retrofit providing 28,000 lumens vs. 21,000 lumens for a 400W mercury vapor lamp.

880W HPS retrofit clear lamp produces 102,000 initial lumens vs. 55,000 lumens for the clear mercury vapor lamp it replaces. Mean lumen increase 106%.

Caution: Because of difference in location of the light source with respect to the fixture or reflector, retrofitted lamps may project a different light pattern.

This pattern has not been a problem at Gallaudet College, but may be in other applications.

Helpful Hint: If your staff has a hard time deciding if existing ballasts are lead or lag type and/or applicable for retrofit lamps, GET Sylvania manufactures a ballast testor for ballasts 40 to 100 watts, 525 volts maximum - for about $50. That is less than the retail cost of a high pressure sodium lamp.

W.S. = Watt Saver
W.M. = Watt Miser
K.F. = Krypton Flood

At Gallaudet College we have standardized on these retrofit reduced wattage lamps as applicable in various fixtures.

HAD BEEN USING	CONVERTED TO	ILLUMUNATION ON TASK	WATTS SAVED PER LAMP
40W 48" T12 Fluorescent	34W 48"T12 W.M. II	Approx. Same	8
75W 96" T12	60W 96"T12 W.S.		
110W 96" T12 H.O.	95W 96" T12 H.O. W.S.		
40W A-19 Incandescent	34W AT-19	Same or More	6
60W A-19	54W AT-19	Same or More	6
60W R-30	44W ER-30	22% More	16
75W R-30	60W R-20	20% Less	15
	60W R-30	23% Less	15
	44W ER-30	Same or More	31
100W A-19	90W AT-19	Same or More	10
	60W R-20	Same or More	40
	60W R-30	Same or More	40
	67W ER-30	Same or More	33
	75W R-30	Up to 25% More	25
100W PAR-38 Flood	90W ER-30	33% Less	10
150W A-23	135W At-21	Same or More	15
150W R-40 Flood **	135W PAR-38 K.F.	Up to 238% More	15
	100W PAR-38 Flood	Up to 133% More	50
	100W BR-40 Flood	Up to 7% More	50
	90W ER-30	56% More	60
	75W PAR-38 Flood	Up to 48% More	75
	67W ER-30	Same or More	83
150W PAR-38 Flood	135 PAR-38 K.F.	Same or More	15

** NOTE: The amount of illumination for the substitution lamps as shown depends on the application and arrangement. The ER substitutes are essentially for recessed fixtures. Also the voltage plays an important part in the light output.

Energy Conservation Systems, Inc.

ANNUAL ENERGY COSTS FOR VARIOUS SIZE LAMPS/BULBS

Wattage of Lamp	4¢ Per Kwh Hours Burned		5¢ Per Kwh Hours Burned		6¢ Per Kwh Hours Burned		7¢ Per Kwh Hours Burned		8¢ Per Kwh Hours Burned		9¢ Per Kwh Hours Burned		10¢ Per Kwh Hours Burned	
	6 Hrs.	24 Hrs.	6 Hrs.	24 Hrs.	6 Hrs.	24 Hrs.	6 Hrs.	24 Hrs.	6 Hrs.	24 Hrs.	6 Hrs.	24 Hrs.	6 Hrs.	24 Hrs.
Incandescent														
1 25 Watt	2.20	8.76	2.75	10.95	3.30	13.14	3.85	15.33	4.40	17.52	4.95	19.71	5.50	21.90
2 25 Watt	4.40	17.52	5.50	21.90	6.60	26.28	7.70	30.66	8.80	35.04	9.90	39.42	11.00	43.80
1 40 Watt	3.52	14.00	4.40	17.50	5.28	21.00	6.16	24.50	7.04	28.00	7.92	31.50	8.80	35.00
2 40 Watt	7.04	28.00	8.80	35.00	10.56	42.00	12.32	49.00	14.08	56.00	15.84	63.00	17.60	70.00
3 40 Watt	10.56	42.00	13.20	52.50	15.84	63.00	18.48	73.50	21.12	84.00	23.76	94.50	26.40	105.00
4 40 Watt	14.08	56.00	17.60	70.00	21.12	84.00	24.64	98.00	28.16	112.00	31.68	126.00	35.20	140.00
1 60 Watt	5.24	21.04	6.55	26.30	7.86	31.56	9.17	36.82	10.48	42.08	11.79	47.34	13.10	52.60
2 60 Watt	10.48	42.08	13.10	52.60	15.72	63.12	18.34	73.64	20.96	84.16	23.58	94.68	26.20	105.20
3 60 Watt	15.72	63.12	19.65	78.90	23.58	94.68	27.51	110.46	31.44	126.24	35.37	142.02	39.30	157.80
4 60 Watt	20.96	83.84	26.20	104.80	31.44	125.76	36.68	146.72	41.92	167.68	47.16	188.64	52.40	209.60
1 75 Watt	6.56	26.28	8.20	32.85	9.84	39.42	11.48	46.00	13.12	52.56	14.76	59.13	16.40	65.70
2 75 Watt	13.12	52.56	16.40	65.70	19.68	78.84	22.96	91.98	26.24	105.12	29.52	118.26	32.80	131.40
3 75 Watt	19.68	78.84	24.60	98.55	29.52	118.26	34.44	137.98	39.36	157.68	44.28	117.39	49.20	197.10
4 75 Watt	26.24	104.80	32.80	131.00	39.36	157.20	45.92	183.40	52.48	209.60	59.04	235.80	65.60	262.00
1 100 Watt	8.76	35.04	10.95	43.80	13.14	52.56	15.33	61.32	17.52	70.08	19.71	78.84	21.90	87.60
2 100 Watt	17.52	70.08	21.90	87.60	26.28	105.12	30.66	122.64	35.04	140.16	39.42	157.68	43.80	175.20
3 100 Watt	26.28	105.12	32.85	131.40	39.42	157.68	45.99	183.96	52.56	210.24	59.13	236.52	65.70	262.80
4 100 Watt	35.04	140.16	43.80	175.20	52.56	210.24	61.32	245.28	70.08	280.32	78.84	315.36	87.60	350.40
Fluorescent*														
1 6 Watt	.72	2.80	.90	3.50	1.08	4.20	1.26	4.91	1.44	5.60	1.62	6.30	1.80	7.00
2 6 Watt	1.44	5.60	1.80	7.00	2.16	8.40	2.52	9.82	2.88	11.20	3.24	12.60	3.60	14.00
1 8 Watt	.88	3.52	1.10	4.40	1.32	5.28	1.54	6.16	1.76	7.04	1.98	7.92	2.20	8.80
2 8 Watt	1.76	7.04	2.20	8.80	2.64	10.56	3.08	12.32	3.52	14.08	3.96	15.84	4.40	17.60
1 19 Watt Circline (Derated)	1.40	5.60	1.75	7.00	2.10	8.40	2.45	9.80	2.80	11.20	3.15	12.60	3.50	14.00
1 15 Watt	1.56	6.32	1.95	7.90	2.34	9.48	2.73	11.06	3.12	12.64	3.51	14.22	3.90	15.80
2 15 Watt	3.12	12.60	3.90	15.75	4.68	18.90	5.46	22.12	6.24	25.20	7.02	28.35	7.80	31.50
1 19 Watt Circline	1.92	7.72	2.40	9.65	2.88	11.58	3.36	13.51	3.84	15.44	4.32	17.37	4.80	19.30
1 20 Watt	2.12	8.40	2.65	10.50	3.18	12.60	3.71	14.70	4.24	16.80	4.77	18.90	5.30	21.00
2 20 Watt	4.20	16.80	5.25	21.00	6.30	25.20	7.35	29.40	8.40	33.60	9.45	37.80	10.50	42.00
1 22 Watt Circline	2.20	8.76	2.75	10.95	3.30	13.14	3.85	15.33	4.40	17.52	4.95	19.71	5.50	21.90
1 30 Watt	3.08	12.28	3.85	15.35	4.62	18.42	5.39	21.50	6.16	24.56	6.93	27.63	7.70	30.70
2 30 Watt	6.12	24.52	7.65	30.65	9.18	36.78	10.71	42.90	12.24	49.04	13.77	55.17	15.30	61.30
1 32 Watt Circline	3.24	12.96	4.05	16.20	4.86	19.44	5.67	22.68	6.48	25.92	7.29	29.16	8.10	32.40
1 40 Watt	4.20	16.80	5.25	21.00	6.30	25.20	7.35	29.40	8.40	33.60	9.45	37.80	10.50	42.00
2 40 Watt	8.40	33.60	10.50	42.00	12.60	50.40	14.70	58.80	16.80	67.20	18.90	75.60	21.00	84.00
1 22/32 Watt Circline	5.44	21.72	6.80	27.15	8.16	32.58	9.52	38.02	10.88	43.44	12.24	48.87	13.60	54.30

*Cost figures shown include wattage loss through ballast.

Energy Conservation Systems, Inc.

COMPARATIVE LUMEN OUTPUT OF VARIOUS COMBINATIONS OF INCANDESCENT & FLUORESCENT LAMPS

	Fluorescent	1 4 Watt	1 6 Watt	1 8 Watt 2 6 Watt 1 19 Watt (Derated)	2 8 Watt 1 19 Watt Circline 1 15 Watt	1 22 Watt Circline	1 20 Watt	2 15 Watt	1 32 Watt Circline	1 30 Watt	2 20 Watt 1 22/32 Watt	1 40 Watt	2 30 Watt	2 40 Watt
Incandescent														
1 25 Watt		140 190												
2 25 Watt			290 380											
1 40 Watt				400 580 590 445										
1 60 Watt 2 40 Watt					800 800 880 870 890									
1 75 Watt						1,100 1,180								
3 40 Watt							1,260 1,335							
1 100 Watt 2 60 Watt								1,760 1,720 1,740						
4 40 Watt									1,820 1,780					
2 75 Watt										2,300 2,380				
3 60 Watt											2,520 2,920 2,610			
2 100 Watt 4 60 Watt 3 75 Watt												3,150 3,440 3,450 3,540		
4 75 Watt													4,600 4,720	
3 100 Watt 4 100 Watt														6,300 5,160 6 980

Lumen output shown is lamp manufacturer's specification. It does not consider light loss through lens/diffuser, which may range from low of 6% to high of 55%, depending on material used, thickness and translucency.

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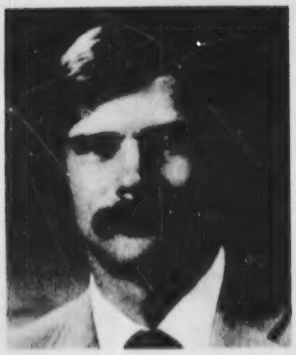

Predicting Energy Savings at a University with Cogeneration

By Gary L. Reynolds
Iowa State University

Introduction

The Iowa State University (ISU) Physical Plant presently provides utilities to its campus in the form of cogenerated heating steam and electricity, chilled water, domestic water, and compressed air. One hundred percent coal-fired boilers provide the primary source of power for these utilities. Thus, a reduction in utility use is reflected in a reduction in coal input to the boilers. However, interactive effects within the power plant preclude a straight one-to-one conversion of a Btu saved at the building boundary to coal saved at the power plant. (See Figure 1.)

In September, 1980, the ISU Energy Conservation Task Force (ECTF) was charged with the task of reducing campus energy consumption through improved control of off-hour building usage. Among the recommendations made by the ECTF was the possibility of a campus-wide shutdown during the 1980/81 Christmas holiday period. The final decision to implement this energy conservation opportunity (ECO) partially depended on the saving in energy that could be accrued during this period. This paper discusses the analysis technique that was used to predict this energy saving and compares it to that actually achieved. Also, this paper indicates several methods of analysis for evaluating other ECO's recommended by the ECTF.

Facilities Description

The power plant has six boilers that deliver steam at two different thermodynamic states. Three boilers deliver steam at 250 psig and 500°F and three boilers deliver steam at 400 psig and 750°F. This steam is delivered to two primary steam consumers and to two secondary steam consumers. The two primary steam consumers are five turbine generator (TG) sets and two centrifugal chillers (CC). The secondary consumers are parasitic loads and pressure reduction stations (PRS). Three TG sets use 250 psig steam and two TG sets use 400 psig steam. Steam is extracted at two stages of the turbines to produce 90 psig (medium pressure) and 6 psig (low pressure) steam. Total electrical generating capacity is extraction rate dependent and varies from 30 megawatts to 40 megawatts and is used for station power, running air compressors, campus needs, and outside sales. Extracted steam is used for deaerating, campus heating, driving two absorption chillers to meet winter chilled water requirements, and outside sales. Two 5000 ton centrifugal chillers are used to meet the summer air conditioning needs of the campus and outside sales. Boiler steam is also used to run pumps and other auxiliary equipment. Further, exhaust from steam operated feed water pumps can be used to supplement the 6 psig extraction steam.

Analysis

Baseline profile development. Power plant operators manually record equipment operating conditions on an hourly basis. These "log sheets" are maintained and summarized by Physical Plant personnel. For this analysis, these data were used to calculate average hourly operating conditions for each major power plant component on a monthly basis. (It should be noted that the log sheets were not always complete, that automatic recording meters were not always working and that, in some instances, required information was not recorded.)

The average hourly values, for a given component, were then plotted to produce typical daily profiles for the months of interest. The energy transfer values of interest for the Christmas shutdown period were boiler Btu output, TG set Btu input, low and medium pressure extraction steam Btu output, and electrical production. Typical profiles are plotted in Figures 2, 3, 4, and 5 for January.

Energy Conservation opportunities (ECO's) implemented on central campus are directly reflected in the low and medium pressure steam and electrical profiles. Thus, these profiles establish the baseline from which the impact of ECO's can be determined.

Electrical profile. The electrical generation profiles reflect past operating conditions for a given month. Typically, as shown in Figure 5, automatic fan start up in some buildings at 6 a.m. increases the electrical demand. People arriving at work increase the electrical demand by turning on lights and processes. The peak requirement for the day (winter months only) occurs at approximately 3 or 4 p.m. People leaving work at the end of the day reduce the electrical requirements to a new level until 10 p.m. when automatic fan shutdown reduces the electrical demand still further. As the final late working people finish for the day, the electrical requirements are at a minimum from approximately 1 a.m. to 6 a.m. This electrical profile is typical for winter months.

This typical electrical profile also provides insight into several points of interest. (See Figure 6.) First, the impact of automatic fan shutdown and the resulting energy savings can be easily determined for the existing conditions. Second, the electrical load due to occupancy can be readily identified and thus planned reductions in this load can be easily quantified.

Low and medium pressure steam profile. Low and medium pressure steam is used for heating, humidifying, and processes on campus and is also sold. Typically, as shown in Figure 4, the heating load requirements decrease starting at approximately sunrise. As the day proceeds, internal loads (lights, people, and processes) and solar gain displace steam heating requirements. At the end of the working period (approximately 5 p.m.), these internal loads decrease and the low and medium pressure steam requirements increase. The heating load increases as the internal loads and outside air temperature reduce gradually through the evening until 10 p.m. At 10 p.m., with automatic fan shutdown, the heating load decreases again. However, as building heat capacitance is expended through the night, more and more heating demand is placed on the low and medium pressure steam sources. This profile is typical for the winter months.

TG set input profile. The TG set input requirements reflect the demand being placed on the TG sets by the extracted steam and electrical generating requirements. (See Figure 3.) The profile is relatively flat in the early morning,with a slight rise until 7 a.m., reflecting the increased demand for heating steam. There is a sharp increase from 7 a.m. to 9 a.m., following the electrical demand increase, and a continuous downward trend as the electrical load levels off and the heating requirements decrease. At 5 p.m. when the electrical demand suddenly decreases, the heating load increases to replace the lost internal heat gains. Thus, the TG set input profile remains relatively flat from 5 p.m. to 10 p.m. As automatic fan shutdown takes place at 10 p.m., there is a simultaneous reduction in electrical demand and heating demand as some of the buildings on campus are allowed to cool down under night setback control. Then TG set input requirements increase again as building heat capacitance is expended and heat is required to maintain the night setback temperature.

The TG set input profiles, along with the extraction steam and electrical profiles, indicate the interaction that occurs between the different energy consuming and energy supplying components of a cogeneration system.

1980/81 Christmas shutdown evaluation. A substantial number of ECO's were implemented during the Christmas break of 1979/80. Therefore, separate profiles were developed for December 1-21, 1979 and for December 22-31, 1979. These profiles are presented in Figures 7-10 for boiler output, TG set input, extraction steam output, and electrical generation respectively. The reductions achieved during this period are represented by the crosshatched areas and indicate (1) a 12.9 percent reduction in boiler output resulting in a 14 percent reduction in coal consumption, (2) a 21.2 percent reduction in TG set input, (3) a 13.1 percent reduction in extracted steam and, (4) a 26.9 percent reduction in electrical usage.

The estimate of energy savings for campus shutdown during Christmas 1980 was based on the energy savings that resulted from ECO's implemented during Christmas 1979 and an extrapolation of these savings to include increased building participation, increased implementation of existing ECO's, and reduced occupancy. A desktop computer was used to program the TG set extraction curves and the algorithms for reduced fan operation, building temperature setback, closed outside air dampers, and reduced occupancy. This computer program accounts for the interactive effects that these ECO's have on one another as well as the effects of the TG sets. The computer program was then used to generate new Christmas shutdown 24-hour profiles by increasing the previous years' savings proportionally to that indicated by the proposed ECO's. The new profiles were then integrated to determine the new operating

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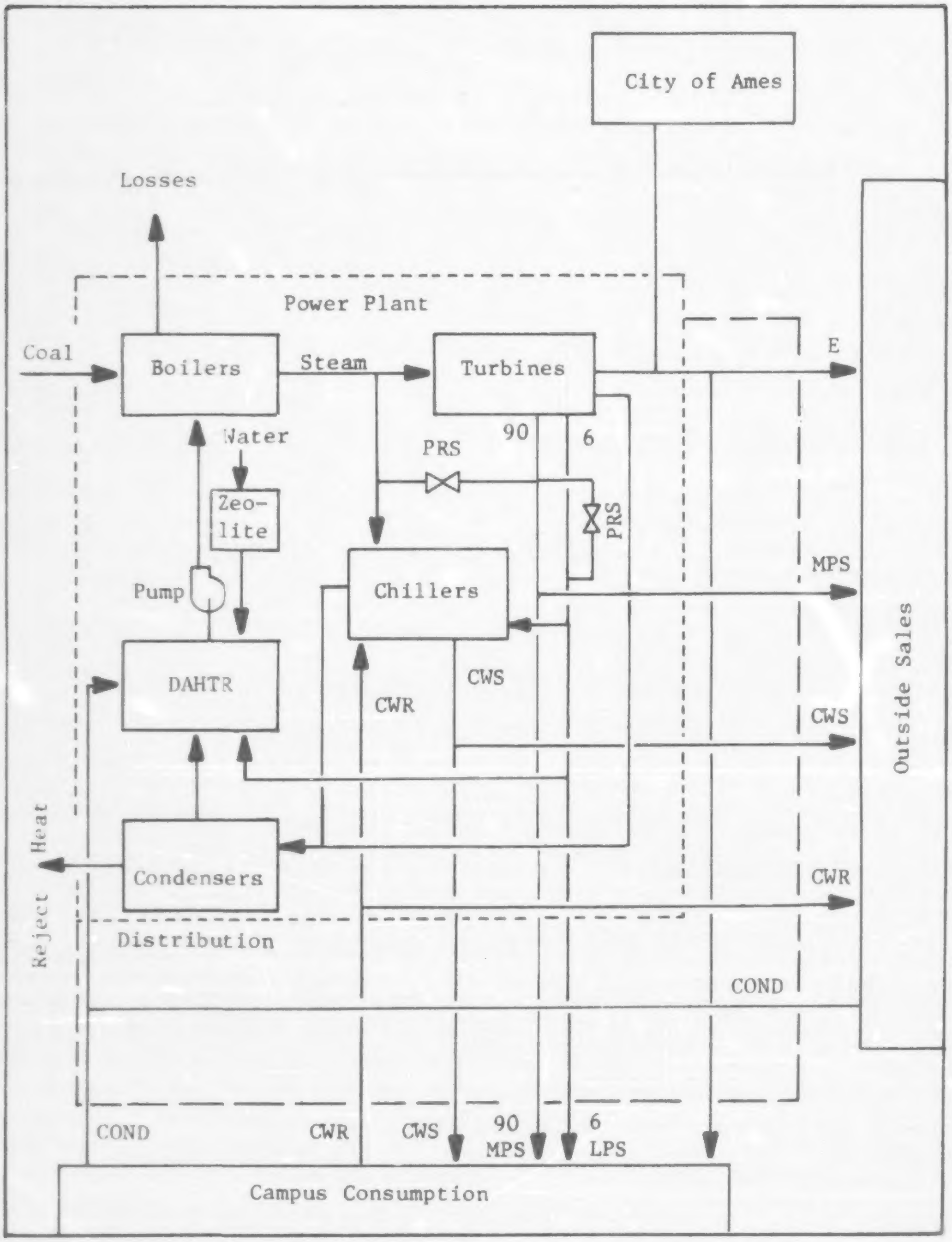
levels that could be expected during the Christmas 1980 shutdown period.

Results

The computer program generated profiles indicating that approximately \$5700/day (\$1.86/10^6 Btu) of coal could be saved over normal school operation. After the Christmas break of 1980, the coal consumption records were examined to determine the energy and dollar savings that actually occurred. This was done by examining the three-week period just prior to the Christmas break period and comparing it to the Christmas break period. The pre-break period averaged 12,075 x 10^6 Btu/day and 25°F outside air temperature. The break period averaged 9,114 x 10^6 Btu/day and 24°F. (The temperatures were checked to ensure that there was not a significant weather influence.) At \$1.86/10^6 Btu, the energy savings cited here resulted in a coal cost avoidance of \$5500/day. This falls fairly close to the estimate (within 4 percent) that was made using the computer program and the average hourly profile technique.

Conclusions

The interactions of a buildings' utilities are a complicated phenomena and combining these interactions with those of a cogeneration system makes the analysis more difficult. However, transforming the raw data of the power plant log sheets into typical monthly profiles provides a greater understanding of the cogeneration system's response to the changing demands being placed on the various utilities. Further, insight can be gained into the effect that certain types of ECO's will have and in some instances quantitative results can be obtained.


City of Ames
Losses
Power Plant
Coal
Boilers
Steam
Turbines
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Water
PRS
90
6
Zeo-lite
PRS
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Chillers
MPS
Outside Sales
DAHTR
CWS
CWR
CWS
Heat
Reject
Condensers
CWR
Distribution
COND
COND
CWR
CWS
90
MPS
6
LPS
Campus Consumption

Figure 1. ISU Power Plant and Utility Distribution

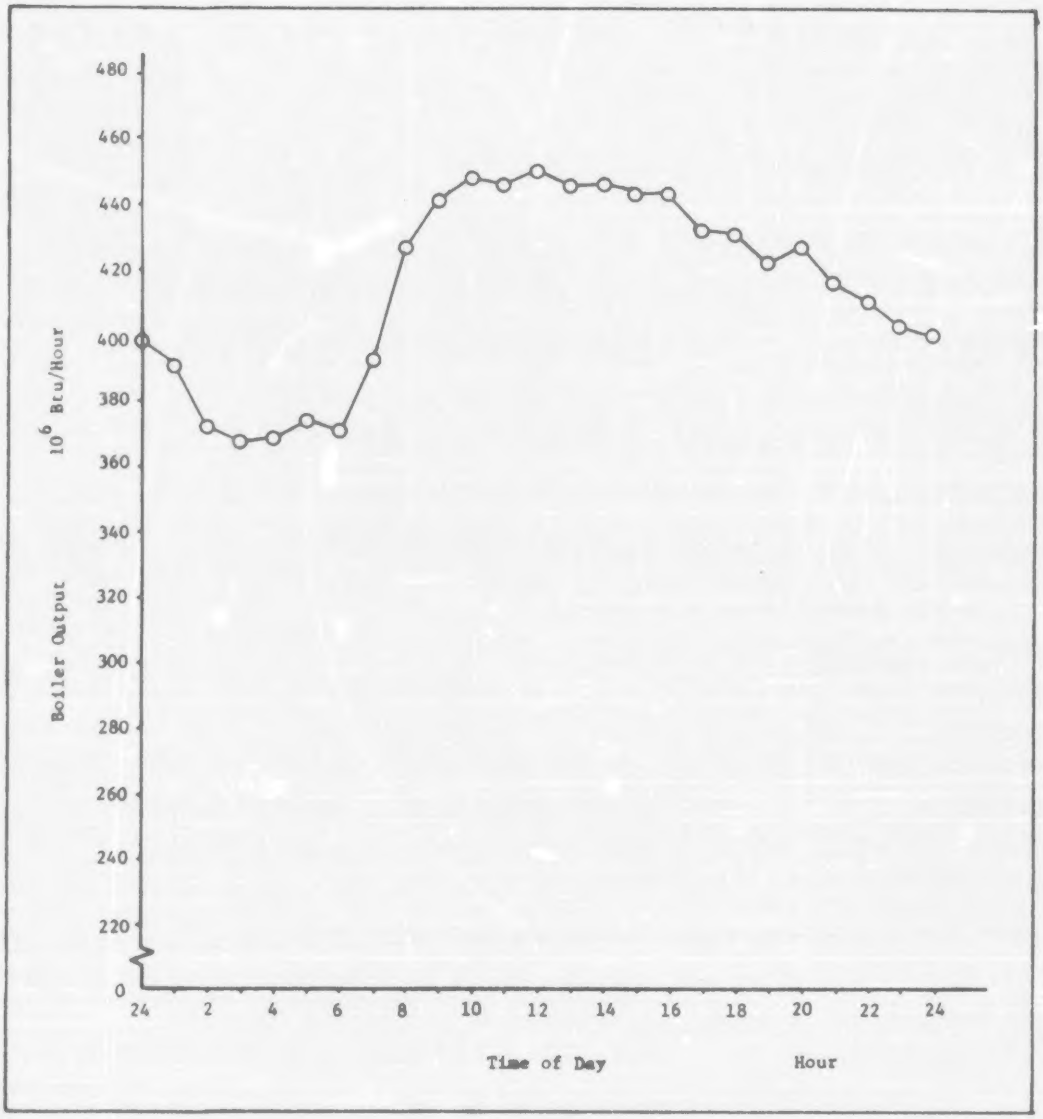

Figure 2. January, 1980 Boiler Output

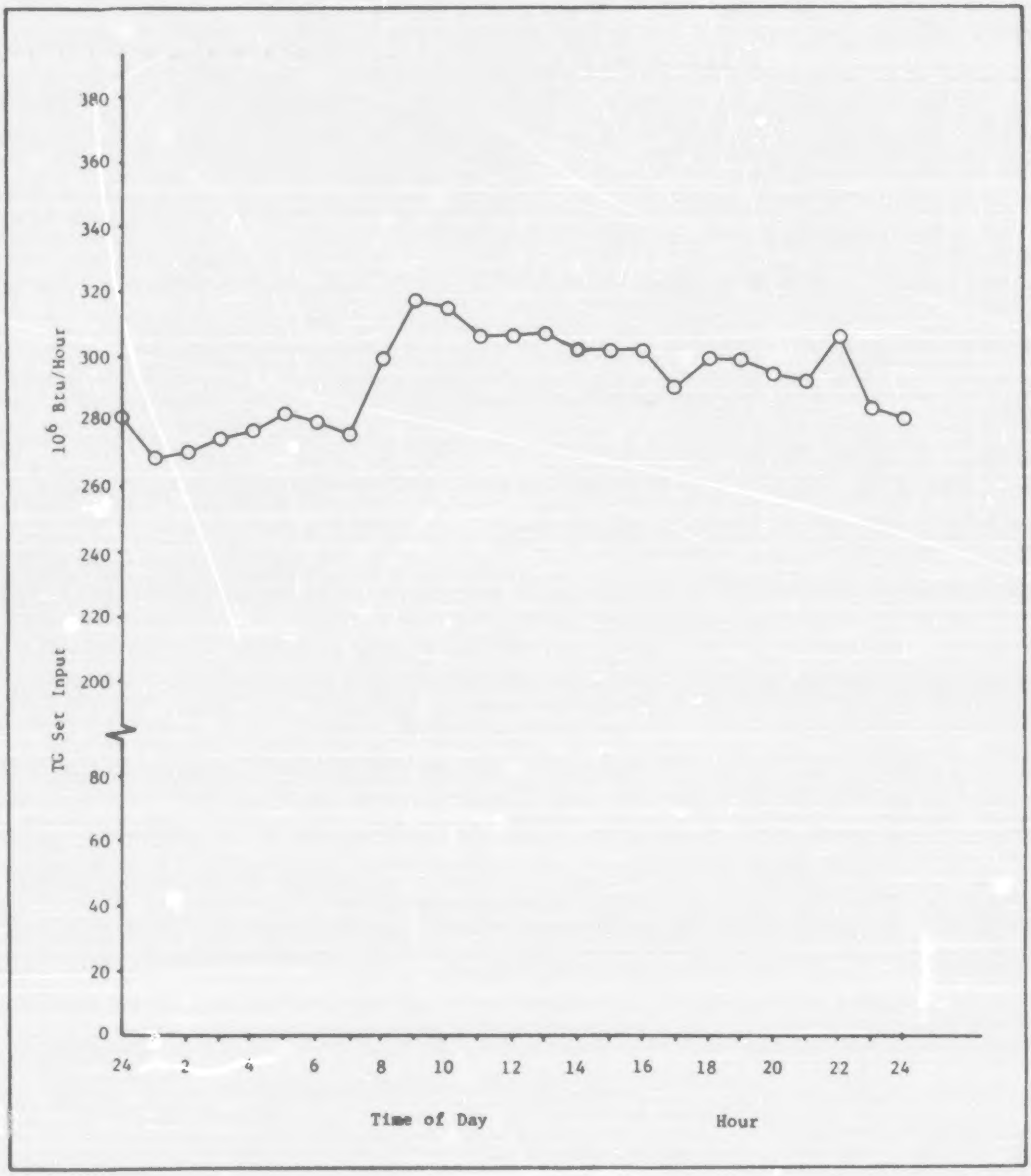

Figure 3. January, 1980 TG Set Input

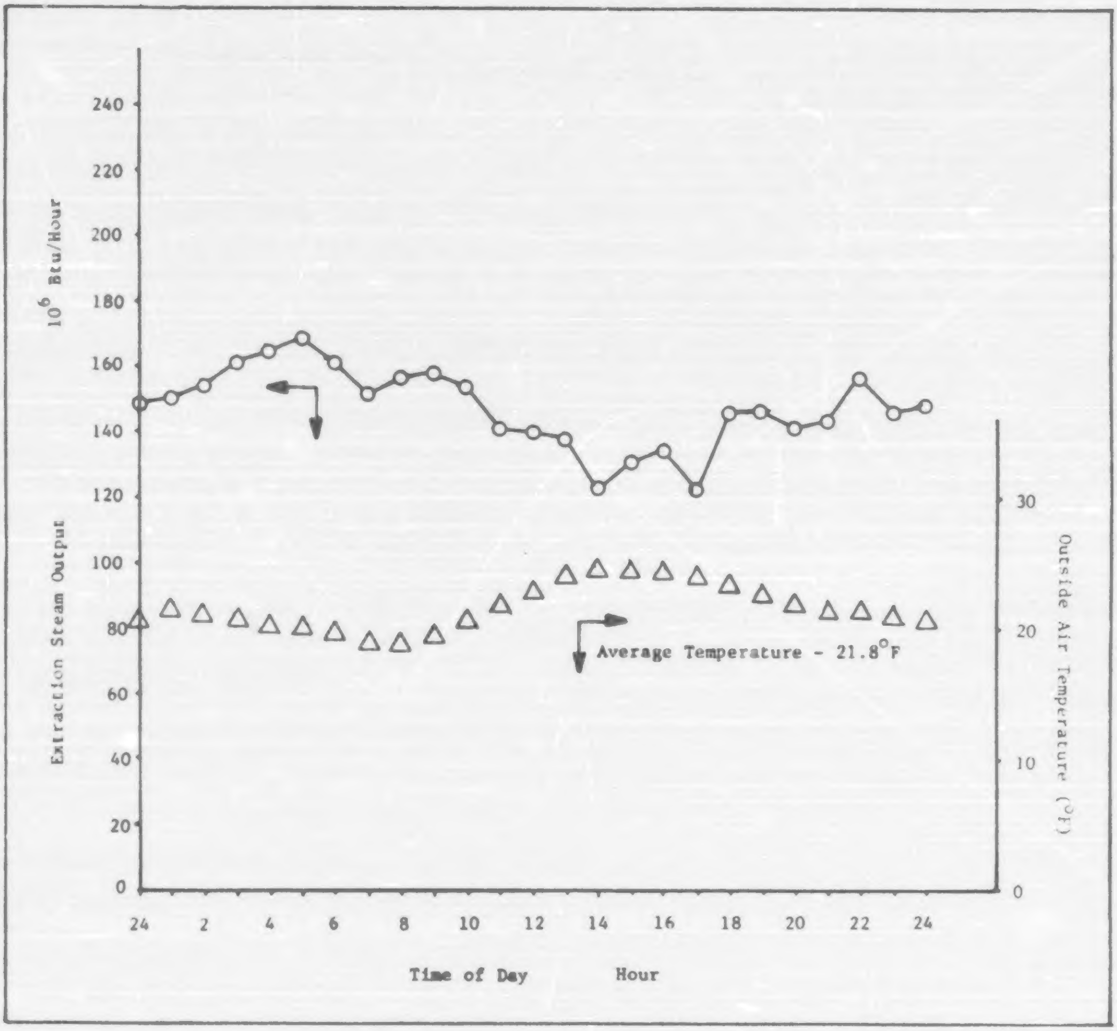

Figure 4. January, 1980 Low and Medium Pressure Extraction Steam Output

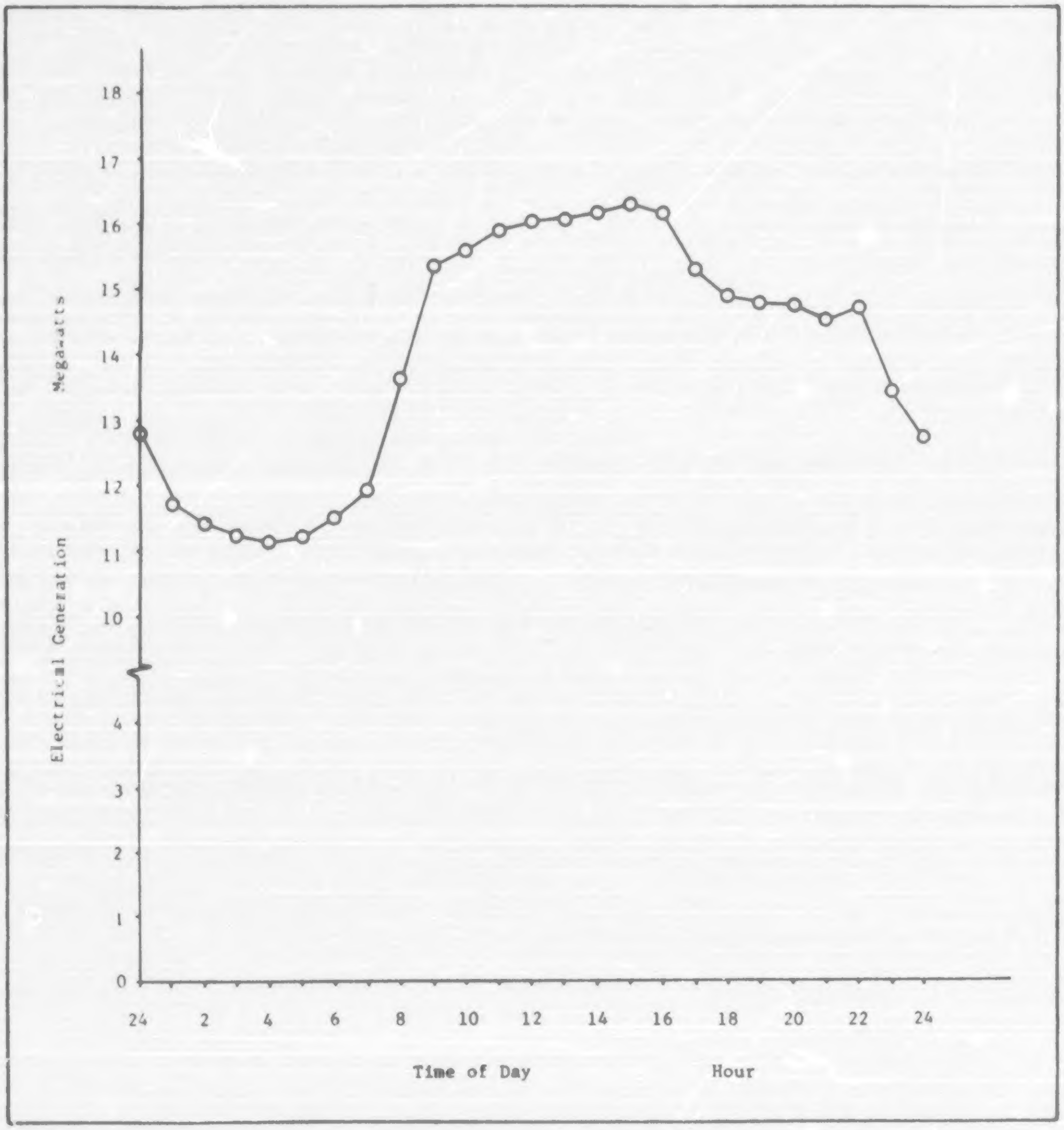

Figure 5. January, 1980 Electrical Generation

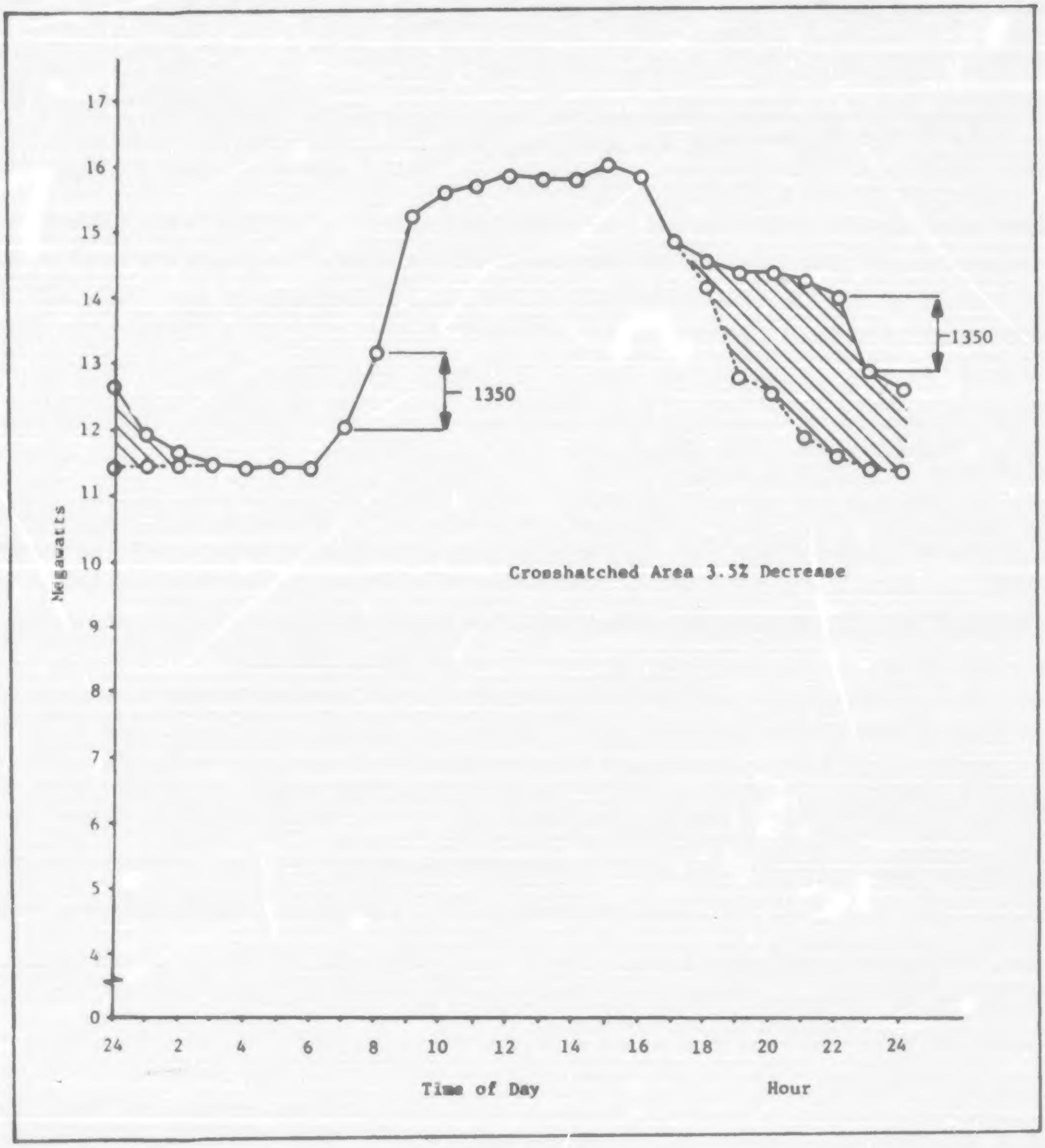

Figure 6. Automatic Fan Control and Early Evening Campus Shutdown Profiles

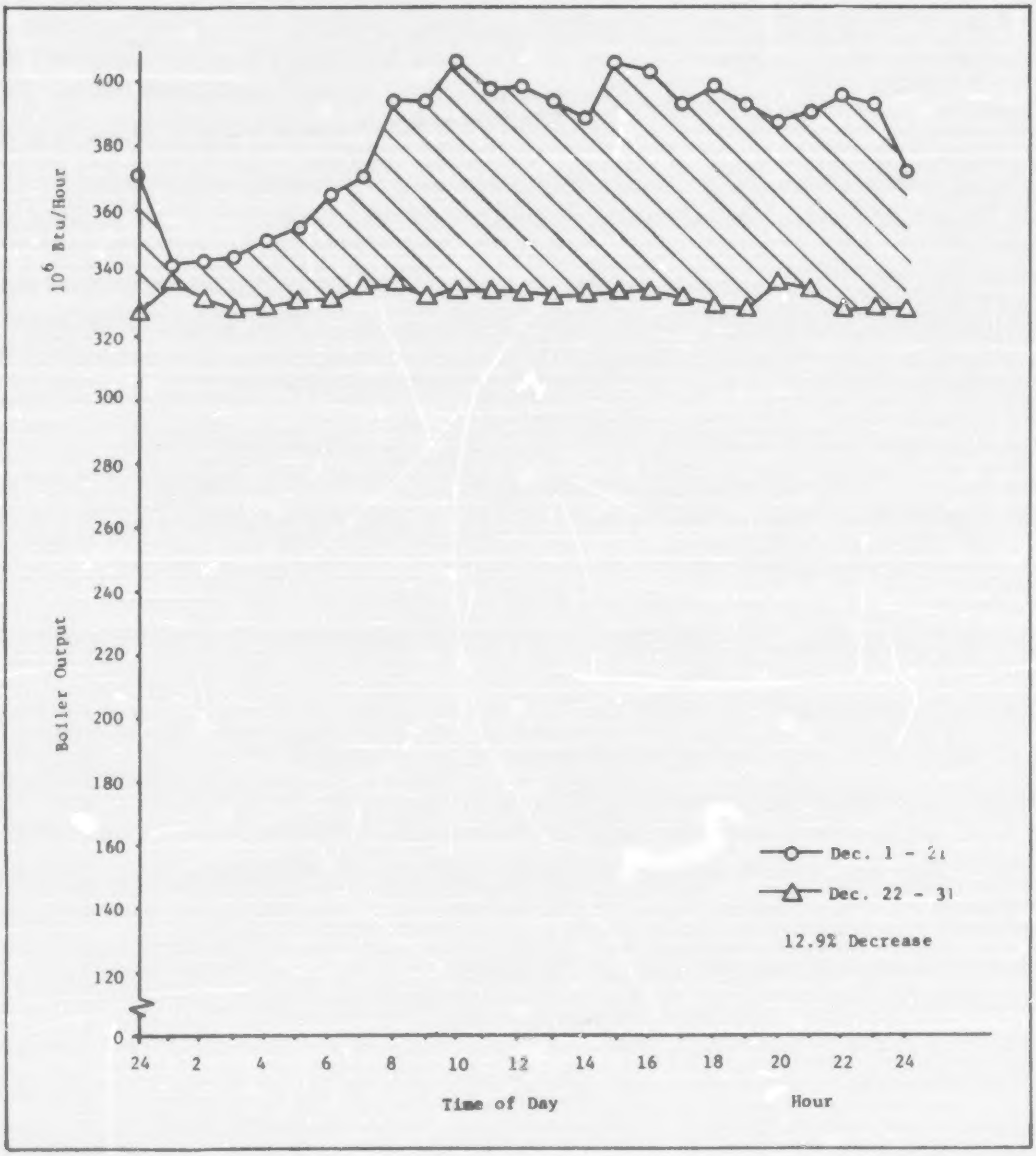

Figure 7. December 1979 Boiler Output

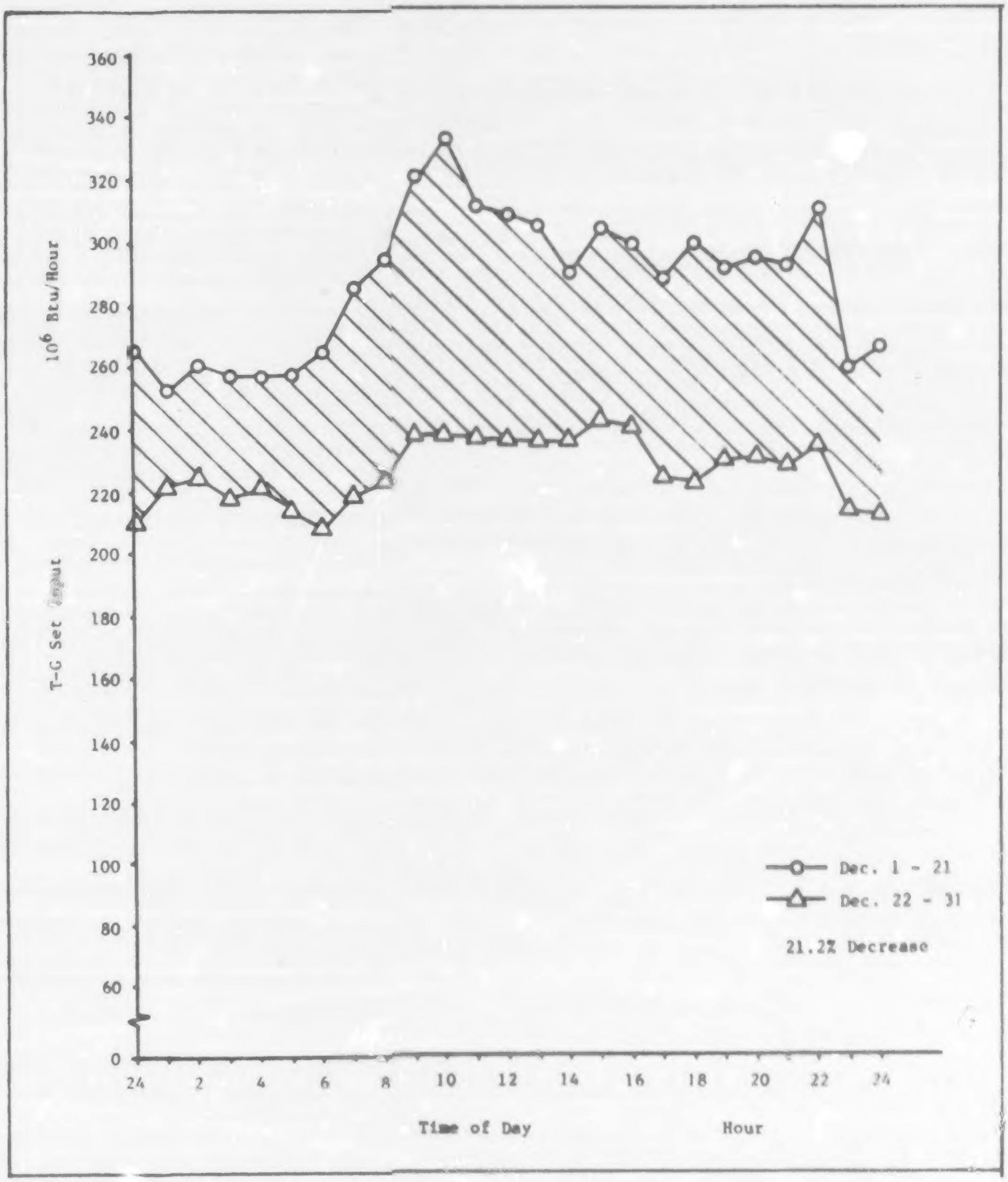

Figure 8. December 1979 TG Set Input

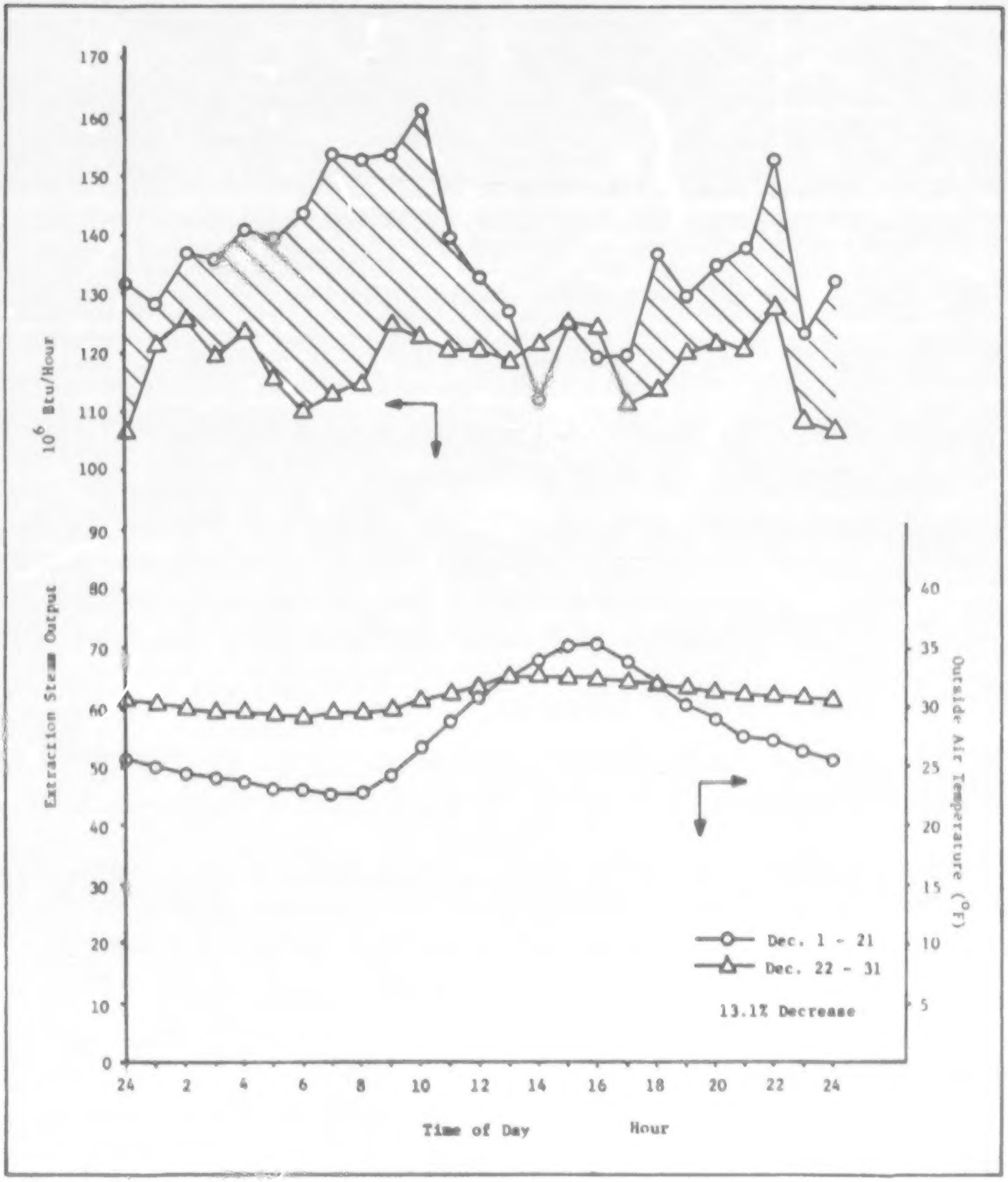

Figure 9. December 1979 Low and Medium Pressure Extraction Steam Output

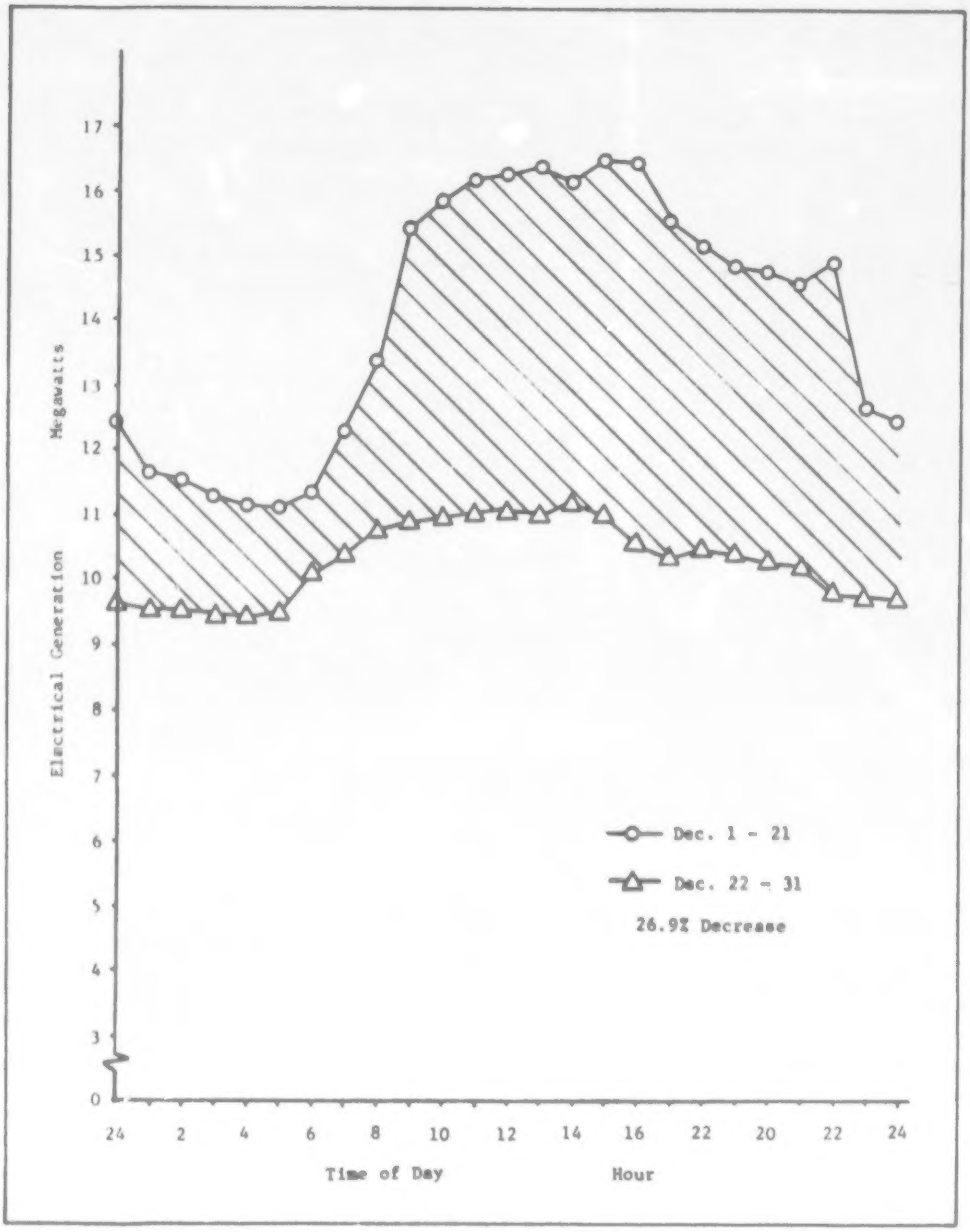

Figure 10. December 1979 Electrical Generation

Maintenance Programs

PHOENIX '82
APPA

Maintenance Manpower Crisis

Ralph F. Jansen
TPC Training Systems

Many facilities face a serious shortage of maintenance manpower. This paper discusses the extent of the problem; how we got ourselves into this situation, and some things we can do to correct it. The crisis comes from three specific areas:

1. New jobs, resulting from growth. Failure to find and train adequate numbers of people to fill these jobs will definitely restrict the economy's ability to grow.

2. Retirement, with a large percentage of retirements occurring among employees in the skilled trades. Replacements will require extensive skills training.

3. Technology, particularly solid-state electronics. Rapidly expanding technology complicates the training of new and replacement maintenance craftsmen, and requires retraining and upgrading of existing maintenance employees.

Just How Severe Are These Problems?

It is estimated that there are currently about 15 million people in maintenance-related occupations. The most recent issue of the U.S. Dept. of Labor's "Occupational Outlook" report shows that there will be 17-million new jobs by 1990. Based on the present ratio of maintenance to production workers, this means nearly 2 million new maintenance-related jobs by 1990.

Even more serious, recent investigation shows that a large percentage of existing maintenance employees will be retiring during the same 10-year period. With 15 million people currently employed in maintenance-related occupations, as many as 7 million may retire by 1990.

Combining new jobs and replacements, there could be as many as 9 million new maintenance workers to be trained by 1990. It has been estimated that 75% of all new workers entering the maintenance field have no formal training. As many as 500,000 untrained workers each year seems to be a conservative estimate. The burden of this training falls on the shoulders of the physical plant manager.

How Did We Get Into This Situation?

Immediately after World War II, thousands of G.I.'s returned to the workforce. Many had received skills training in the service, and many others enrolled in training programs leading to skilled jobs under the G.I. Bill.

There was no shortage of skills since industry had also trained large numbers of skilled workers to support the war effort.

Then in 1957 we faced the Sputnik syndrome. All our young people were pushed into becoming engineers or scientists. At the same time we had a generation of "Depression-Era" parents who were saying,

> My children are going to get a good education so they won't have to "work" for a living.

We began to build up a stigma regarding work. Vocational training lost its appeal. With a cadre of qualified people holding the skilled jobs, the only place for those who could not or would not make it in college was the low-skilled or unskilled labor pool. It is this large pool of unskilled labor that must be tapped (and trained) to help solve both the unemployment and the skills-shortage problems. If we do not take steps now to start training from this group to meet our maintenance needs, industry and the academic facilities communities will be competing for help from the same diminishing pool of existing skilled crafts.

What about the problem of retraining or updating existing workers? Is craft pride dead? The truth is, while it may be dormant, there is still plenty around. Craft pride is really the outward expression of a person's competence and confidence in his ability to do his work. The thousands of maintenance people involved in training programs are solid evidence of craft pride. And they should have pride. They are filling an important responsibility, while thousands of over-educated and under-skilled are out of work.

Too often, though, we see the attitude among older workers,

> I don't need training--I have been doing this work for 20 years. I have 20 year's experience.

Without related training, you might ask,

> Does this person really have 20 years of experience or just one year's experience 20 times?

All professionals (doctors, lawyers, teachers, engineers) take refresher courses. There is no reason why the same principle should not apply to professional craftspersons as well. It has been estimated that new knowledge is developed at the rate of about 10 percent per year. Also, we all lose knowledge at a rate of about 10 percent per year through disuse. This means we should spend at least 20 percent of our time in training just to stay even.

Most educators agree that the workplace is the best learning laboratory. So, realistically, maintenance employees enrolled in continuing education programs are doing a lot more than just staying even. Combining formal related training with experience, they are advancing themselves in their chosen field. It is an important field, and maintenance professionals are gaining new prestige in our society. The point was probably made best by John Gardner when he was Secretary of the Dept. of Health, Education & Welfare. He said,

> The society that scorns excellence in plumbing because it is a humble activity, yet accepts shoddiness in philosophy because it is an exalted activity will have neither good plumbing nor good philosophy. Neither its pipes nor its theories will hold water.

Plant Engineering Magazine Survey

This manpower crisis is not new. As early as 1958, Plant Engineering magazine asked its readers,

> What is the major plant engineering or maintenance problem facing industry today?

The overwhelming response indicated that the major problem was,

> Finding and training maintenance craftsmen.

Ten years later, a U.S. Office of Education study showed that 80 percent of U.S. plants had a shortage of maintenance personnel.

As a result, in 1968, Plant Engineering magazine conducted a survey to see if its readers agreed with the apparent seriousness of the situation. Other objectives of the survey were to determine in what specific areas the training need was most critical; and to find out what kinds of programs, texts, and study formats were currently being used, which worked, and which did not. Finally, we hoped to locate suitable training materials and methods that might be available to help solve the problem.

The survey provided a great deal of useful information about the training situation in general. For example, 97 percent of the plants felt training was needed, but less than half had training programs for maintenance craftsmen. Of those plants without training programs, a number had tried training but had given up on it. Thirty-four percent were considering training. Over half had neither staff nor materials to do the job.

Of those who had a training program, 77 percent were dissatisfied with it. Some were totally dissatisfied, and probably about to become part of the statistics of those who tried training and gave it up. Part of the survey related to the urgency of the training need. Plant Engineering readers said that 89 percent of their maintenance craftsmen had a need for training. All these factors, combined, indicated a pretty serious situation concerning maintenance training.

To back up the fact that many organizations recognized the seriousness of the situation, nearly 80 percent of the respondents said they permit or encourage training on company time, and 84 percent pay for training materials or courses. That is an important statistic to remember--approximately 80 percent of the organizations surveyed pay for training, on company time. Estimates of training costs, including wages and burden, run as high as $15 to $20 per hour. So it is up to the physical plant director to see that his school's training dollar is well spent.

Training Methods - What Works, What Doesn't and Why

We also analyzed what was wrong with existing training programs--why so many were considered unsatisfactory. Methods analyzed included classroom, correspondence, and programmed learning.

The classroom, with its instructor/lecture format, has been the usual maintenance training method. The problem is, it just has too many obstacles to effective maintenance craft training. Scheduling is often the biggest problem. Emergencies arise during the class, and key personnel are called back to the job. Even if it does not disrupt the entire class, it does interrupt the training for those who are called out of the classroom.

In any training class, you are inevitably faced with differences in learning speed, age, individual capabilities, and work experience. These differences all adversely affect the learning situation in the classroom. Slow learners hold back the progress of the class, boring those trainees who learn faster. If the instructor adjusts his instruction to keep pace with the quicker individuals, he will soon be over the heads of the slow learners, and he may lose them entirely.

If supervisors are taught in the classroom along with craftsmen, two detrimental effects result. The supervisor is often reluctant to participate actively in the classroom discussion for fear of losing the respect of his men. And, the craftsmen may be hesitant to display their ignorance in front of their "Boss." Other problems with traditional classroom instruction are simply the availability of adequate facilities and the difficulty in finding good instructors.

The main alternative to classroom instruction has been correspondence courses. These are often expensive, involving cumbersome contracts. One of the most serious problems occurring with correspondence course training, though, is the time delay involved in sending in a lesson and having the corrected answer sheet returned. Often, there is no direct control of the training effort by physical plant supervision. Often, correspondence course materials are used that are not designed specifically for physical plant maintenance. So-called industrial electronics and instrumentation courses have turned out to be little more than warmed-over radio-TV repair courses. The result is eventual loss of motivation for the trainee.

As a result of all these things, according to a study made by the Federal Trade Commission, correspondence course training suffers from about 95 percent dropout rate. You cannot have an effective training program if only 5 percent of the trainees complete it.

Programmed instruction is being used as an alternative to correspondence courses. Often programmed instruction is not organized into a complete training system. Programmed instruction courses put together from several sources must be carefully selected to ensure continuing development.

The fact that straight programmed instruction is just not suitable for the classroom should be considered by companies who have instructors and facilities available. With some programs, it is difficult to maintain a high level of motivation because programmed instruction is often too basic and contains excessive redundancy. Finally, because of the nature of straight programmed instruction, it is difficult to look up information. Therefore, it is not suitable later as reference material.

Evaluating what we had learned from current experience in industrial training, we felt a new approach was called for. Working together with a firm of educational consultants, we discovered a new, supervised, self-study method called adjunctive programing--a proven individual training system, developed, tested, and perfected with literally millions of trainees in military and government programs.

Supervised self-study uses modern educational technology based on the same sound precepts as programmed instruction. That is:

1. The materials are written to support clear objectives.
2. Prerequisite knowledge is established through pretesting.
3. Information is presented in short segments.
4. Frequent exercises develop understanding.
5. The student gets immediate feedback.
6. Materials are revised based on student performance.

Supervised self study provides two of the three basic components of a complete training program--knowledge and computational skills. Manual skills are developed in your plant, using actual equipment.

This training method is appropriate for use by all levels, from apprentices to first-line supervisors. In several plants, even higher supervision and engineers have found the programs valuable as refresher training. It is especially helpful in preparing supervisors to handle multi-craft groups, and to upgrade the knowledge of current craftsmen.

While no educational level has been established for trainees in this type of program, one obvious requirement is that they be able to read and write. Most people agree that a maintenance employee must be able to read and write to be successful. Information comes daily in written form: work orders, manufacturer's maintenance manuals, operating instructions, policies and procedures, safety precautions. Using video as a substitute for reading does not solve the problem.

A supervised self-study program overcomes every major objection to other systems. It is self pacing, provides reinforcement and correction as necessary. Feedback (and reward) is immediate. There is no demotivating time delay. The trainees can immediately start applying what they have learned. The supervisor is in a position to make sure the trainees have mastered one section before going on to the next. Because of the nature of adjunctive programmed material, it can be used in several ways. It provides lecture, directed discussion, and review quizzes if an instructor wants to use the classroom approach.

However, do not overlook the fact that there are certain advantages to using this type of material as it was intended--as a self-study training program. With the traditional approach, everyone starts and finishes at the same time, but the results are variable with grades falling in a typical bell curve. In the self-instructional method, the time required to cover the material is variable, but the results are consistent--everyone attains success.

Establishing Training Program Guidelines

In any training program, all new trainees should be given basic courses first, following the rule of going from the simple to the complex--from the known to the unknown. Establish a schedule and stick to it. If at all possible, conduct the training during working hours, mornings are better than afternoons. Just before lunch is probably the best time from the standpoint of trainee alertness. Just after lunch is the worst. And do not expect success if trainees are required to study totally on their own. In fact, if the training is related to the present job, it is illegal to require employees to take training on their own time. Time devoted to training may vary from one to four hours per week, on a schedule ranging from one hour once a week, to two hours twice a week. A lighter schedule will result in lack of continuity of the program and loss of motivation. Two-hour sessions are about maximum for adult learning, and more than two sessions per week begins to approach the saturation point. There is insufficient time to schedule work experience to correlate with the related instruction.

With supervised self-study, there is no advantage in trying to keep the group studying the same lesson. You may give both mechanical and electrical courses in the same room at the same time--something you cannot do with conventional classroom training. Some individuals may have the initiative and experience to want to progress more rapidly. Others will need more time than you planned. Keep in mind that it is success you are after. With self-paced learning, time required varies, but success is constant.

There is no lecturing involved with this training method. The supervisor needs only supervisory skills to run the program. Also, no formal classroom is needed. Any quiet spot with tables and chairs and adequate lighting will serve. The result is lower cost, and it means you can get a training program started with a minimum of preparation and aggravation.

No special equipment is needed. Supervised self-study provides visual representation and program exercises without projection equipment or teaching machines. In addition to cost savings, advantages include no equipment to break down, no distractions--and training can be conducted anytime, anyplace.

Here are some tips on selecting self-study course materials. A course manager's handbook should accompany the course, and provide complete instructions. This will make it easier to keep the program running effectively.

Language should be controlled, but must not "talk down" to trainees. New terms should be introduced and explained so the trainee can use them properly. Because math is often a problem, the need for math can be shown first. Then the trainee is given the math needed to do the work. Safety is especially important in maintenance. A Course must stress proper safety attitudes throughout the program.

Most maintenance employees recognize that the path to advancement and higher pay is through better performance on the job. Courses appeal to employees if they are related to their work. To help build competence and confidence, course materials must stress the practical versus the theoretical. In other words, a good training program will contain all need-to-know information rather than nice-to-know.

Also, the training techniques used must be self-motivating. Trainees should get frequent encouragement as they progress through each lesson. Needed:

1. Motivated learner
2. Job-related course material
3. Opportunity to interact with the course material
4. Opportunity to apply knowledge to the job

Finally, being in complete control of the training, the supervisor is in a position to keep the instruction relevant to the job and fill the training responsibility. The confidence level will improve, bringing an increase in craft pride. As productivity goes up and downtime goes down, morale will be higher (and your own job will be a little easier). Best of all, you and your school will be doing your share to help solve the growing crisis in maintenance manpower.

Prescription for Preventive Maintenance

by John Skubal and Harold Harp
Johnson County Community College

Everyone in the business of maintenance has fought the problem of coping with equipment that breaks down at the worst possible time. Too often we assume that this is just part of the business, an expensive, time-consuming, and frustrating part. However, with a Preventive Maintenance program, it no longer has to be.

Before we investigate how to set up a Preventive Maintenance program, let us be realistic and not expect a panacea that will eliminate all of the problems associated with maintenance. However, with systematic planning and research, we can discover where the main problems are likely to arise. Furthermore, we can probably attribute them to less than 10 percent of our mechanical equipment. With this planning and research accomplished, a maintenance department may identify 90 percent of the potential mechanical problems before they become mechanical failures. We can then truly manage our time and staff.

The first step in establishing a Preventive Maintenance program is to sell the idea. Preventive Maintenance programs mandated by the maintenance supervisor seldom work. They must be sold to the administration of the institution, if necessary, and they must be sold, more importantly, to the staff involved--the people who will make it work.

Usually, the administration will be easier to convince because Preventive Maintenance programs have so many benefits in the administrative mind. A Preventive Maintenance program is proof of efficient administration, evidence of managing time, people, and programs. A good program is organized, efficient, and, most impressive, cost effective--for example, documented prolonged equipment life is extremely convincing. Good management can only be accomplished when it is done by plan and not by crisis; a good Preventive Maintenance program provides this plan and eliminates most of the crisis.

The staff, the people who will make the program succeed, may be a bit harder to sell. This is a situation tailor-made for true participative management. No program will work nearly as efficiently if it is forced on a staff as it will if they have helped develop it, adopted it, and support it. This support is especially important to a Preventive Maintenance program since its success depends on the function of the staff in organized maintenance teams, some members to do research, some to lead, and some to do the actual mechanical work. Since the first step in any new program is to overcome the staff's reluctance to change it, it is imperative that they participate in the change and clearly see that many of the changes will be changes they make, not only because their participation will increase their willingness to support the Preventive Maintenance program but also because the program requires their participation. Their ideas and suggestions are borne out of firsthand experience. It must be utilized. One way to accomplish this participation is through Problem/Solution workshops. These are rather structured discussion groups in which participants brainstorm by first identifying a problem, then examining the effects of the problem, searching for the causes of the problem, and finally trying to devise methods of eliminating those causes. The result, of course, is the solution to the problem. This process works for problems ranging from a particular piece of equipment such as an air handling system to entire buildings. At any rate, to sell the idea of a Preventive Maintenance program, the staff must be convinced that they have true involvement in the program and that the program will eliminate many of their problems and make their jobs more efficient.

After selling the idea to both administration and staff and involving the staff in the groundwork, the next step requires determining which equipment should be included in the Preventive Maintenance program. This requires an examination of the critical nature of all equipment, analyzing the effect each piece of equipment has on the entire operation.

Once the equipment to be included in the program has been determined, that equipment must then be assigned to priority groups. A good starting point is to assign all equipment to one of the following three groups.

Group A

This includes the really critical equipment. Assign to this group all equipment which would stop the entire operation if it failed. Examples of this type of equipment are the water plant, the heating plant, the cooling plant, and the air handling unit.

Group B

This includes the equipment which would seriously affect the operation if it failed but not bring it to a halt. Examples of this equipment are small motors over one horsepower, transformers, and faulty lighting.

Group C

This includes equipment which might cause inconvenience if it failed but not seriously affect the operation. Examples of this equipment might include water fountains and small motors under one horsepower.

Where each piece of equipment goes in each different Preventive Maintenance program, of course, depends on the nature of the institution and its priorities. Let us emphasize that this step is a very important

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one because the equipment priority chart will be used to organize the actual Preventive Maintenance program. Utilization of the staff involved with the equipment and familiar with the effects of the equipment failure makes this task easier and more accurate. As the program matures, more groups may be used, but three is a good beginning point.

We said earlier that a Preventive Maintenance program requires planning and research. So far we have discussed planning. Now comes the research, learning as much as possible about the equipment to be maintained. The following four sources of information are where we begin.

Equipment Manuals

These offer a wealth of information about any given piece or system of equipment, including its mechanical nature, operation, maintenance procedures and schedules, names of parts suppliers, component manufacturers, and specific instruction sheets for installation, operation and service.

Component Manuals

The second, related source to research should be the component manuals. Since many items of equipment are obviously made up of several components, these manuals are invaluable. For example, to establish a Preventive Maintenance schedule for an air compressor, information about all of its parts would be necessary. However, sometimes the equipment manuals do not provide information for certain parts which are purchased by the manufacturer of a system of equipment, such as the previously mentioned air compressor. Such information is available only by writing to the manufacturer of the component part--be it the motor or filter assembly--for the specifications and service recommendations for that particular component.

Experiences of the Staff

The staff should be surveyed to identify the equipment which requires repetitive maintenance and for suggestions they might have regarding the maintenance procedures for that equipment.

Equipment History

Finally, the history of the equipment maintenance should be researched. If an operation does not already have such a history, one should be established immediately. Essentially, this is a notebook containing the completed work orders for each building, and much can be determined from this valuable source. For instance, if a work order appears for the replacement of a motor, and a quick look through the book reveals that it had been replaced just three years before, obviously there is a flaw in the system somewhere.

The point to remember is that the key ingredients to a successful Preventive Maintenance program are already in the possession of most operations. They remain only to be collected, researched, and used.

Now comes the critical part of the process--the actual development of the Preventive Maintenance program. The first step in that development demands that the maintenance and operating procedures and recommendations be categorized and analyzed--broken down building by building, machine by machine, and component by component. Next, maintenance tasks are assigned to components and to the appropriate staff. This may be accomplished efficiently by any number of systems--card file, memory typewriter, or computer. All of this is done while keeping the priority groups in mind, of course. The Preventive Maintenance program should be developed in easily managed phases, obviously assigning the most critical elements first and adding equipment in order of predetermined priority.

The next step in the development of the program is the assignment of the staff to its appropriate teams and the development of their schedules. With the team selection rests success or failure. As previously mentioned, no program of any kind can succeed without the support and cooperation of the people who will make it work. Therefore, the interests and abilities of the employees should be kept in mind when making team assignments. To begin, a team needs three types of assignments.

Research

This should be a person who is detail oriented, who can sit down with the manuals and the equipment history of work orders and identify, assimilate and present significant information.

Team Leader

A team leader should be someone with demonstrated leadership ability who can manage and communicate with the team and the supervisor.

Mechanics

The mechanics should be personnel experienced in inspection who can make minor repairs and cooperate with the trades.

In short, proper placement of personnel is of the utmost importance to the success of the Preventive Maintenance program. Each team should be made aware of the nature and importance of each individual team member's function and how it relates to the task and success of the entire team and, further, each team should understand how its responsibilities contribute to the success of the entire Preventive Maintenance program. In short, each individual must see that he or she contributes to the program.

At this point, the Preventive Maintenance program is in existence and functioning, but it is not finished, for in fact, the program is never finished. This next step is a constant one--analyzing and evaluating the Preventive Maintenance program. The supervisors have to be religious in their efforts of checking records and making evaluations of maintenance--that is, inspecting work to be certain that assigned tasks were done according to schedule and specifications. Another important part of the evaluation process is to compare the previously mentioned Equipment History notebook of completed work orders from the previous years to the work orders collected during the Preventive Maintenance program. Suggestions and evaluations should be sought from the staff since they will undoubtedly be forming conclusions concerning how and when maintenance tasks should be done.

The previous step, analysis and evaluation, and the next step, revision, are never ending ones because personnel and equipment constantly change. With the documentation gleaned during the analysis and evaluation procedure, the supervisor should be able to identify those areas of the Preventive Maintenance program which require change and what change should be required. For example, analysis and evaluation may indicate the need to purchase different systems or components, to reassign team functions or members, or to arrange additional training for certain staff.

The important thing to remember about a Preventive Maintenance program is that it is not an expense but a savings and, therefore, a necessity. Every institution already has its ingredients from documentation to manpower. They must be discovered, organized, and managed.

Safety and Health Testing Programs for Hazardous Chemical Handlers

By Dean A. Ramsey
The Ohio State University

In today's society, it has become commonplace as an employer to be faced with legally defending charges of negligence or proving that programs are safe.

Nearly everyone in physical plant operations faces a certain amount of danger in a given assignment, but in the case of handling agricultural chemicals, accidents may not have immediate results or effects.

More than likely as a physical plant administrator, you are totally unaware of problems encountered with chemical absorption and if you are, you probably have done little or nothing in your department about it.

There is a very simple method of detection and a relatively low cost program available to everyone and it is my firm belief we should all be concerned enough to give it a try.

During the summer of 1979, one of our Landscape Maintenance Section student employees was off work with the "flu". This diagnosis seemed to be of no unusual consequence and after he improved, he returned to work. Within ten days to two weeks, he again complained of the same symptoms and missed several more days of work. The employee was assigned to a chemical application crew, but with 50 or 60 student employees, and some 35 Civil Service employees on the roles of this section, his absence caused very little concern.

By some coincidence, this person's father happened to be Vice President of a firm that supplied most of our fertilizers, fungicides, insecticides, etc. The father recognized through his experience, a possibility of chemical poisoning. Since he was closely related to the field of turf and plant management, he had his son examined for this possibility.

I received a call from him after confirmation of the results and he proceeded to tell me what had happened.

The "flu" had turned out to be poisoning through chemical absorption. The nausea, the high temperature, and the various other symptoms would have normally been passed off and treated as flu, even by most physicians, without blood testing for certain elements.

Luckily, for the University, our problem had been discovered by someone closely related to the chemical applications industry with no interest in causing problems or we would have either had a legal battle to contend with, or possibly no recognition of the existence of a deadly problem until someone had a very serious accident.

It was also discovered how this employee had ingested chemicals. He had been assigned to a crew spraying broadleaf weeds in lawns using 2,4-D, 2,4,5-TP (Silvex), and other mixtures as the problem required. We were not really as safety conscious as we should have been, or thought we were because the employee had been wearing "Hush Puppy" type shoes with spongy soles. These were his work shoes and worn only at his job, thus the recurring problem of absorption, then recovery off the job. (As a matter of information, the arch of the foot, the groin, behind the ear, etc. are most sensitive to absorbance.)

It was certainly evident that we were absolutely "hiding our heads in the sand" with reference to the safety of employees involved in handling agricultural chemicals.

I was very fortunate to have access to two people involved professionally with this specific problem and interviewed them to get more information and try to improve our programs. These people were Dr. Joseph Bianchine, Chairman of the Department of Pharmacology, College of Medicine, at OSU, and Robert Miller, PhD, Vice President of the ChemLawn Corporation, and previously a professor of Agronomy at OSU.

After a rather extensive educational program on my part, we established basically a two part safety program that has now been in existence through two full chemical application seasons of 1980 and 1981 with excellent results. The two parts of the program are a Safe Handling Education Program and Health Testing.

Since any person handling potentially dangerous chemicals is subject to adverse effects of constant or accidental overexposure, either of the parts of the program are equally important. By knowing the materials and how to handle them, and a biomonitoring program to insure health levels, the result is the employee and the University being protected. Potential legal entanglements at some future date can certainly be eased or completely diverted with records maintained of this program.

When an employee is selected to work on the Chemical Application Crew, he is listed on a form (Exhibit A) and is given a two-part handout (Exhibits B & C). Exhibit B is a brief, easily understood brochure describing pesticide selection detailing toxicity, compatibility, residual, effectiveness, safety equipment, storage, and disposal procedures. This brochure also compares the hazards of some of the commonly used materials using the LD50 method. LD50 is most easily understood as a value that tells the amount of pesticide or other chemical that would be lethal to fifty percent of a test population in milligrams per kilograms of body weight. These values are listed as either oral or dermal. Exhibit C is a list of shcp rules relating specifically to Pesticide Application. This three page brochure is a fairly precise description of safety equipment, operational procedures, safety rules, clothing, etc.

Both of the above Exhibits are given to each employee and they are

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asked to carefully read and understand what they have read. Afterward, they are asked to initial the record form that they have done so. Concurrently, the supervisor has a personal conference with each employee to emphasize the importance of safety and explain the health testing system.

The health testing system or Cholinesterase Biomonitoring Program is initiated before the seasonal handling of various pesticides begins. This health testing system consists of a brief physical examination aimed mainly at the various internal organs, and standard blood tests. The general health of the individual is established as well as a "baseline cholinesterase" determination (Exhibit D). This baseline then serves as a reference point in subsequent blood tests taken at two-week intervals throughout the season. This information is also entered on the form (Exhibit A) for permanent record. As a simple explanation, Cholinesterase is an enzyme occurring naturally in the blood, nerve tissue, and organs as a protective component, and is measurable.

The blood samples are sent to ChemLawn Laboratory and on their return are entered on the record. If any sizeable variation occurs, the person is removed from the Chemical Application Crew and retested. When, and if, the cholinesterase level returns to "normal", he is put back on his original crew assignment. During this period, we search to find the cause of the problem to be certain a similar accident doesn't occur.

It might be of some interest to note that we have discovered three cases where problems occurred. Two were previous to assignment to a crew. One person had previously had a drinking problem and had liver damage. Further chemical ingestion could have been serious and the blood tests exposed the problem. The second was a case where no cholinesterase was present, thus no protective mechanism. This occurs in about one percent of the population and these people should not handle chemicals.

The description of our safety program sounds complicated, but in reality, once established is very simple. It consists of brief understandable education materials, basic shop rules, health testing, and of course, records. The cost has been minimal considering the safety insurance provided for our employees and the University. This program has cost us somewhat less than $1,000 per season for up to eight employees.

The question of personnel problems resulting from establishing such a program is usually asked. There should be no problem if the correct approach is used to make employees feel that this is a positive program and is for their protection. It should be made clear that the work they perform is not necessarily dangerous, but simply to protect them from accidental occurrences. In our case, we talk to each individual involved on a "one-to-one" basis, and ask their opinions in the presentation. The acceptance has been unanimous and even welcomed.

Again, I would like to emphasize the importance of a program of safety to protect both the employee and the University when possibilities of chemical ingestion can occur.

Cholinesterase tests show quickly and simply by comparative means when something has or is occurring. Safety rules and procedures are a must and education of employees is a prime requirement.

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exhibit a

Safety Testing and Training : Chemical Treatment Crews

								additional tests		
Employee Name	date of Safety Discussion	issued brochures	employee read brochures	initial physical exam date	approved for assignm't	chol. level	2 week test date/level	date + level	date + level	date + level

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Pesticides and Safety

exhibit b

Pesticides by their nature are poisons, yet if handled and used properly they are beneficial. Pesticides have saved millions of peoples lives by controlling insects and pests which spread malaria, bubonic plague, typhus, yellow fever, encephelitis and other sicknesses. Without pesticides as much as one-third of our present food production would be lost, causing world wide famine. The United States uses more pesticides than any other nation, but the United States produces the purest, highest quality food on earth.

Pesticides have contributed much to our well being but have also created problems. People die because of improper usage of pesticides, some wildlife species have almost become extinct and harmful residues in our food and bodies have become prevalent.

Each pesticide on the market today has been tested extensively both by the company producing it and the Federal Government. Approximately 4 to 10 years of research and many millions of dollars are needed before a pesticide can be marketed. These tests are made on animals such as rats, mice, dogs, etc. Certain individuals may be allergic to a relatively non toxic chemical or its carrier, whereas, others may be very resistant to some of the extremely toxic chemicals. For this reason, each of us must be extremely careful. Sometimes a chemical may cause a specific reaction in the test animal but the same reaction will not be present in humans or vice versa. Thus, caution must be exercised.

SELECTING PESTICIDES

Factors to consider when selecting a pesticide for a specific purpose are:

1. Target pest
2. Toxicity and hazard of the chemical - LD_{50} (dermal and oral), LC_{50} and the primary skin irritation index
3. Phytotoxicity
4. Compatibility
5. Residual
6. Effectiveness
7. Precautionary measures
8. Safety equipment
9. Storage and disposal procedures
10. Formulations

These represent only a few of the many factors that should be considered in choosing the best chemical for a problem. It is important to clearly understand each of the above variables before selecting a pesticide.

Target Pest

An understanding of the target pest is essential for effective control. The life history or disease cycle of an organism can give you a clue for timing treatments. Insecticide and fungicide resistance is another important factor to consider. If the area has reported several cases of resistant varieties of *Sclerotinia hemocarpa*, (causal agent of dollar spot) to the fungicide benomyl (Tarsan 1991), this should be considered in your programming.

Toxicity

An important factor to consider in pesticide selection is the toxicity and hazards of the chemicals. An indication of the toxicity of a chemical is an LD_{50} value. These values have the units milligrams per kilogram of body weight (mg/kg). This number indicates the amount of pesticide (milligrams) that would be lethal to 50 percent of a test population in a single dose. LD_{50} values are the best indicator to compare pesticides, but they have their fallacies:

1. The toxicity of a chemical to man and animals may vary with age, sex, nutritional state, species, type of application and formulation.
2. An LD_{50} value is a statistic that gives no information about the dosage required to kill a small group of animals in a large group.
3. LD_{50} values are for single dosages only. Thus, these values give no information about the possible cumulative effects of a compound.
4. Toxicity indicates the killing ability of a chemical. The LD_{50} value is used to indicate toxicities. They are not used to indicate hazards. A chemical could be very toxic with a low hazard potential. Why? Because of the way the pesticide is used or misused. The way a pesticide is formulated can also influence its hazard potential.

LD_{50} values are expressed as dermal LD_{50} or oral LD_{50}. When the words dermal or oral are not present, you can usually assume that the number is an oral value.

An oral LD_{50} value is determined by feeding a pesticide to a test animal for two weeks to find the minimum amount of chemical that is lethal to 50 percent of the population. The lower this number, the more toxic the chemical.

A dermal LD_{50} value is determined by applying the pesticide directly to the skin of test animals, allowing continuous skin contact for 24-hours. The amount of chemical lethal to 50 percent of the test animals is determined.

LC_{50} values are calculated by exposing both female and male test animals to a dust or mist of the pesticide for one hour. This gives a lethal concentration value that can be used to compare the toxicity of one pesticide to another by breathing it. The terms acute and chronic are often used in association with these values, i.e. acute oral LD_{50}. Acute refers to the toxicity of a pesticide over a short period of time. Most of the LD_{50} values refer to acute exposures. Chronic refers to the effect of a pesticide over a long period of time. Chlorinated hydrocarbons are more serious from a chronic exposure than an acute exposure while organophosphate materials are more of a problem with acute exposures.

The primary skin irritation index is another test often used as an indicator of skin irritation by pesticides.

Tables 6-1 and 6-2 summarize toxicity categories. Tables 6-4, 6-5 and 6-6 list LD_{50} values for several pesticides.

Table 6-1. Toxicity Categories for Pesticides

Hazard Indicators	I	II	III	IV
Oral LD_{50}	Up to and including 50 mg/kg.	From 50 through 500 mg/kg.	From 500 through 5,000 mg/kg.	Greater than 5,000 mg/kg.
Inhalation LC_{50}				
(a) Dust or mist	Up to and including 2.0 mg/l.	From 2.0 through 20.	From 20 through 200.	Greater than 200.
(b) Gas or vapor	Up to and including 200 p/m.	From 200 through 2,000.	From 2,000 through 20,000.	Greater than 20,000
Dermal LD_{50}	Up to and including 200 mg/kg.	From 200 through 2,000.	From 2,000 through 20,000.	Greater than 20,000
Eye effects	Irreversible corneal opacity at 7 days.	Corneal opacity reversible within 7 days or irritation perisiting for 7 days.	No corneal opacity irritation reversible within 7 days.	No irritation.
Skin irritation	Severe irritation or damage at 72 hours.	Moderate irritation at 72 hours.	Mild or slight irritation at 72 hours.	No irritation at 72 hours.

Table 6-2. Required Signal Words on the Label and Precautionary Statements by Toxicity Category.

Toxicity Category	Signal Word	Oral, Inhalation, or Dermal Toxicity	Skin and Eye Irriation
I	DANGER POISON (In Red) and Skull and Crossbones (if toxicity category based on oral, dermal, or inhalation)	Poisonous if swallowed (inhaled or absorbed through skin). Do not breathe vapor (dust or spray mist). Do not get in eyes, on skin, or on clothing. (Front panel statement of practical treatment required.)	Corrosive, causes eye and skin damage (or skin irritation). Do not get in eyes, on skin, or on clothing. Wear goggles or face shield and rubber gloves when handling. Harmful or fatal if swallowed. (Appropriate first aid statement required.)
II	WARNING	May be fatal if swallowed (inhaled or absorbed through the skin). Do not breathe vapors (dust or spray mist). Do not get in eyes, on skin, or on clothing. (Appropriate first aid statement required.)	Causes eye (and skin) irritation. Do not get in eyes, on skin, or on clothing. Harmful if swallowed. (Appropriate first aid statement required).
III	CAUTION	Harmful if swallowed (inhaled or absorbed through the skin). Avoid breathing vapors (dust or spray mist). Avoid contact with skin (eyes or clothing). (Appropriate first aid statement required.)	Avoid contact with skin, eyes, or clothing. In case of contact immediately flush eyes or skin with plenty of water. Get medical attention if irritation persists.
IV	CAUTION	(No caution statement required.)	(No caution statement required.)

Child hazard warning "KEEP OUT OF REACH OF CHILDREN" required on the front panel of every pesticide label unless circumstances warrant waiver by EPA Administrator.

A pesticide label indicates the toxicity of the technical material but does not indicate its hazard potential. LD_{50} values are based on pure technical material. A formulator may reduce the toxic effects of pesticides by mixing or diluting them with non-toxic materials. For example, a mixture containing 10 percent of a technical material with a LD_{50} of 10 mg/kg and 90 percent of a non-toxic material has an LD_{50} of 100 mg/kg. If, however, the material with which the pesticide is mixed has an LD_{50}, the LD_{50} of the final production is something other than either value listed above. LD_{50} values can be used only to compare one technical material to another one.

Phytotoxicity

Another criteria for selecting a pesticide is phytotoxicity. This deals with the effect of a chemical on various plant material. The non-target crop as well as the target crop is important. Sevin (carbaryl) is a turfgrass insecticide. In programming the use of carbaryl, it is important to consider that it is phytotoxic to Boston ivy. This information is usually available on the label.

Compatibility

When pesticides are used in combinations or in a mixture, numerous problems may arise. In such cases the components of a mixture are compatible if they can be used together or incompatible if problems develop from using the combination. If two or more pesticides can be used in combination without impairment of toxicity, physical properties or plant safety, they are compatible.

Physical Incompatibility

When mixing two or more pesticides reduces the effectiveness of one or all components, the mixture is chemically incompatible. Most organic fungicides and insecticides should not be combined with alkaline compounds with a pH higher than 7.0. Alkaline reactions significantly reduce the effectiveness of carbamate fungicides and the insecticidal value of compounds such as Parathion and Malathion.

For this reason, lime for the control of algae should not be used with maneb fungicides such as Fore, Manzate, Tersan LSR and Dithane M-45. This is also true for Dyrene, zineb, thiram, captan and most organic insecticides.

Dinocap (Karathane), suggested for the control of powdery mildew, is chemically incompatible with Sevin, TEPP and oil-base sprays. Cycloheximide (Acti-dione), suggested for the control of rust diseases of ryegrass, zoysia, bermudagrass and St. Augustinegrass, is chemically incompatible and should not be used with chlordane.

Chemical incompatibility is frequently the cause of poor performance of multiple pesticide combinations. Before combining any pesticides, read the label on the package or container. If information on compatibility is not specified, it is wise to avoid combination of products.

Phytotoxic Incompatibility

When two or more compounds used in combination result in plant injury, they are incompatible because of phototoxic effects. Mixing organic fungicides with emulsifiable concentrates (EC) insecticide formulations with xylene as the solvent, may cause plant injury. When combining fungicides with liquid insecticides, check the label for compatibility and avoid problems of plant injury. When combining pesticides of unknown compatibility, it is always good to try them first on an expendable turf area before use on lawns.

Placement Incompatibility

Incorrect placement of pesticides is frequently the reason for poor disease and insect control. Placement incompatibility is less obvious than some other types of incompatibility and is sometimes overlooked. When two or more chemicals are used together and applied in one operation, each must end up in the proper place if it is to do the job for which it is intended. Some fungicides are protectants and must be uniformly distributed over the leaf surfaces to protect against invasions of pathogens such as *Piricularia* (Gray leafspot) and *Helminthosporium* leafspot of turfgrasses. Failure to establish a foliar blanket of fungicide protection results in poor control of destructive turfgrass diseases. In order to be effective, insecticides for grub control must be washed off the grass into the soil. Therefore a combination of maneb (Tersan LSR) for the control of leafspot and diazinon for grub control is ineffective because of placement incompatibility.

Another example of the need for correct chemical placement is ferrous sulfate or iron chelate to correct chlorosis (iron deficiency). To be effective, ferrous sulfate must be absorbed by the leaf. If too much water is used when applying ferrous sulfate, some of it will be washed into the soil where it becomes tied up and is ineffective.

PESTICIDE RESIDUAL

The characteristic of a pesticide to persist for a period of time in amounts sufficient to kill pests is referred to as residual. The residual activity of pesticides is of interest because of environmental impacts, the effectiveness of a given pesticide and the cost of controlling a pest. Factors that influence the persistence or residual life of a pesticide include reaction with sunlight; physical displacement by wind, water, machinery, etc.; acid or basic reactions; hydrolysis reactions; temperature; soil type and organic matter; thickness of the thatch layer; initial rate of application and the formulation used.

Table 6-3 shows comparative residual activities of several plant surface and soil applied insecticides.

Table 6-3. Approximate Residual of Several Pesticides

Pesticide	Soil	Plant Surface
Diazinon	3-5 weeks	2 weeks
Malathion	2-3 weeks	5-10 days
Dasanit	10 weeks	4-6 weeks
Parathion	1-2 years	3-7 days
Dylox	30 days	Less than 10 days
Proxol	30 days	Less than 10 days
Baygon	4-6 weeks	—
Sevin (carbaryl)	3-4 weeks	3-10 days
Dursban	6-8 weeks	Less than 10 days
Methoxychlor	32 days	6-10 days
Chlordane	5-10 years	30-36 days
Endrin	6-10 years	24 days
Aldrin	6-8 years	20 days
Dacthal (DCPA)	90-120 days	—
2,4-D	1-3 weeks	—
Banvel (dicamba)	3-6 months	—
MCPP (mecoprop)	1-3 weeks	—
Betasan (bensulide)	4-6 months	—
Tersan LSR (maneb)	7-14 days	—
Tersan 1991 (benomyl)	2-6 weeks	—

These values are not absolute since the actual residual depends on many uncontrollable factors.

EFFECTIVENESS OF PESTICIDES

The history of the effectiveness of a pesticide in the area where it is to be used should be considered. Humidity, moisture, soil and air temperature, soil texture and thatch content are only a few factors affecting pesticide performance.

In general, the most effective weed control occurs at moderate to high temperature and low humidity with good soil moisture condition. Selectivity improves with late afternoon herbicide treatments. However, higher temperatures increase the chance of injury to desirable grasses. This is particularly so when using a post-emergent crabgrass control such as MSMA.

The nature and thickness of the thatch layer effects the movement of Dursban, Diazinon and other insecticides into the rootzone. Failure to control grubs with the use of these chemicals may be due to a tie-up of the chemicals in the thatch layer.

PRECAUTIONARY MEASURES

Precautionary measures for a given pesticide can be found on the label. Information relating to toxicity to birds, wildlife, domestic animals, bees and predacious animals is important. Other information of importance includes runoff hazards, residue tolerances (especially on garden crops) and any other environmental hazard.

Other label information includes a list of safety equipment for application and the proper storage and disposal procedures.

PESTICIDE FORMULATIONS

A pesticide formulation consists of a technical material (active ingredient) plus accessory materials (diluents or carriers). The technical material is that portion of the formulation responsible for the killing action. The accessory material is usually listed as inert. This includes materials such as solvents, emulsifiers, sticking agents, wetting agents and synergists.

Solvents – used to get the pesticide dissolved into the diluent or carrier.

Emulsifier – help stabilize mixtures; oil + water + emulsifier = stable solution.

Sticking agents – added to increase the residual of the pesticide.

Wetting agents – used to improve the coverage of the pesticide on the leaf surface.

Synergist (or activators) – used to increase the killing power of the technical material.

Pesticides come in many forms. Some of the formulations available include the following:

Granules – Granular pesticides are prepared by impregnating (soaking up) or binding a liquid pesticide to granules of calcined clay, corn cobs or other material. A pesticide formulated on granules is usually safer to the applicator to apply than liquid formulations except in cases where granular products contain large amounts of dust.

Wettable powders – With wettable powders (WP), the pesticide is impregnated on a dusty material. They differ from true dust formulations in that a wetting agent is also impregnated on the dust. When mixed with water, they form a suspension with agitation. The powder is abrasive to pumps and nozzles, especially to brass and other soft metals. As mentioned earlier, they should be prepasted before adding to the tank.

Flowables – Flowable formulations are finely ground wettable powder sold as a thick suspension in a liquid to make its addition to water in the spray tank easier. Flowables do not require pre-pasting.

Soluble powders – Soluble powders are powdered formulations which will dissolve in water.

Emulsifiable concentrates – This is a liquid formulation of a pesticide which can be mixed with water to form an emulsion. An emulsion is one liquid dispersed (usually as globules) throughout another liquid. They usually take on a cloudy, white appearance when added to water. Many pesticide active ingredients are not soluble in water but are soluble in oils. In emulsifiable concentrates, the active ingredient is often dissolved in oil with an emulsifying agent added so that the EC can be conveniently mixed with water.

CHOOSING A PESTICIDE

Choosing a pesticide for a given problem is not an easy matter. Many facts must be weighed before a final decision is made. The most important item you have to work with in finding answers to many of the above questions is the label. Read and check the label each and every time you use a pesticide.

SAFE USE OF PESTICIDES
(Read the Label)

Selection of Pesticides

1. Identify the pest to be controlled. If in doubt consult the Cooperative Extension Service or other agricultural authority.
2. Select the pesticide that is recommended by competent authority for the particular pest problem. Consider the effects of pesticide residues that may persist on crops grown in following seasons.
3. Make sure that the label on the pesticide container is current, including the directions for use and precautionary procedures.
4. Purchase only the quantity of material that is needed for a single season.

Transportation of Toxic Chemcials

1. Material of hazardous nature should be marked in a conspicuous manner on the outside of the container.
2. Generally transport in an open-type vehicle – never transport volatile pesticides or chemicals that give off noxious or poisonous fumes in a closed vehicle.
3. Protect pesticides from rain, from puncturing or tearing of containers.
4. Make sure containers are tightly closed.
5. Accidents can happen – *be prepared.*

Handling and Mixing Pesticides

1. Read the label directions and current Cooperative Extension Service recommendations carefully before mixing.
2. Wear the appropriate protective clothing and equipment as specified on the label. Some organophosphate and carbamate pesticides are highly toxic and should be used only by persons thoroughly familiar with their hazards and equipped to follow the required precautions.
3. Handle pesticides in a well ventilated area. Avoid dusts and splashing when opening containers or pouring formulations into the spray apparatus. Do not mix or use pesticides on windy days.
4. Measure the quantity of pesticide required accurately using proper equipment.
5. Don't mix pesticides in areas where a chance of spills or overflows will get into any water supply.
6. Clean up spills immediately. Wash pesticides off skin promptly with plenty of soap and water. Change clothes immediately if they become contaminated.

Applying Pesticides

1. Wear the appropriate protective clothing and equipment as required for toxic materials.
2. Make sure the equipment is calibrated correctly and is always in a satisfactory condition.
3. Apply pesticides only at the rate recommended. To minimize drift, apply only on a calm day and do not work through any clouds or drifts or unsettled dusts or sprays. Do not contaminate livestock and food and water supplies.
4. Avoid damage to beneficial and pollinating insects by not spraying during periods when such insects are actively working in the spray area. Notify neighboring beekeepers as required by legislative regulations at least 24 hours before using the pesticide so that they may take precautionary measures.
5. Keep pesticides out of mouth, eyes and nose. Do not use mouth to blow out clogged lines or nozzles.
6. Observe precisely the waiting periods specified between pesticide use and harvesting and/or entry into a treated area. Post the treated area when required and keep all people and animals out of treated areas as designated on the label.
7. Clean all equipment used in mixing and applying pesticides according to recommendations. Do not use the same equipment in applying insecticides that was formerly used for herbicides.
8. After handling pesticides, bathe skin thoroughly with soap and water and change clothing.
9. Keep complete and accurate records of the use of pesticides.

10. If symptoms of poisoning occur during or shortly after the use or exposure to a pesticide, call the physician and/or get the patient to the hospital immediately. Take the pesticide label with you. It is wise to alert family members and the family physician before using highly toxic pesticides in the event that an accident might occur.

Storage of Pesticides

1. All pesticide rooms, cabinets or sheds should be locked.
2. Do not store pesticides where food, feed, seed or water can be contaminated.
3. Store in a dry, well-ventilated place, at temperatures above freezing, or as directed on the label.
4. Mark all entrances to storage area clearly *"Pesticides stored here – Keep Out."*
5. Keep pesticides in their original containers. Make sure they are closed tightly and plainly labelled.
6. Examine containers of pesticides periodically for leaks and tears. Dispose of leaking and torn containers immediately. Clean up spilled or leaked material promptly.
7. Where possible, a sink for washing should be located in or near storage.
8. Keep an inventory and eliminate all outdated materials. Date containers when purchased.
9. Take precautions of potential fire hazards.

Disposal of Unused Pesticides and Empty Containers

"Empty" containers are *never completely empty*. Always read and follow the directions and precautions on the label of the container:

1. Do not re-use the container.
2. Empty the contents and bury unused chemical at least 18 inches deep in an isolated (marked) location away from water supplies.
3. Break glass containers and bury the pieces as in 2 above.
4. Burn empty fiber and paper containers (except those which contained herbicides). Exercise extreme caution and stay well away from the smoke. Burn in designated areas only.
5. Rinse metal containers with detergent and/or caustic soda solution, punch holes in top and bottom, bury container as in 2 above.
6. If metal container cannot be rinsed, punch holes in top and burn until all paint has been completely burned off the container, using precaustions as in 4 above.
7. Bathe thoroughly and change to clean clothing after contact with pesticides.

If accidental poisoning does happen, follow these steps:

Keep calm.

Telephone your doctor, the emergency room of the nearest hospital or your Poison Control Center right away.

Give all details – read the label of the substance swallowed.

Check the label for an antidote. Follow the instructions carefully.

If you go to the doctor's office or hospital, take the poison container with you.

Remember . . . your calm, cool and *quick* action can mean the difference between life and death.

In almost every major city there is a poison control center which has the antidote for almost every conceivable substance. You should know the telephone number and if poisoning occurs, have your doctor call to receive the antidote. Also every chemical company has a 24 hour medical service number that you may contact to get Poisoning Information on their chemicals.

Remember! How you use the pesticide determines the safety of the pesticide.

Table 6-4. Acute Oral and Dermal LD_{50} Values of Insecticides

Common Name	Trade Name	Chemical Classification	LD_{50} Oral	LD_{50} Dermal
aldrin	Aldrite	chlorinated hydrocarbon	39	98
aspon	Aspon	organic phosphate	1700	3830
propoxur	Baygon	carbamate	128	1000
chlordane	Chlordane	chlorinated hydrocarbon	335	840
diazinon	Diazinon	organic phosphate	466	900
chlopyrifos	Dursban	organic phosphate	163	2000
trichlorfon	Dylox, Proxol	organic phosphate	500	2000
ethion	Ethion	organic phosphate	119	915
heptachlor	Heptachlor	chlorinated hydrocarbon	100	195
dicofol	Kelthane	chlorinated hydrocarbon	1100	1230
carbaryl	Sevin	carbamate	850	4000
diazinon	Spectracide	organic phosphate	466	900
carbophenothion	Trithion	organic phosphate	32	1270
methoxychlor	Marlate	chlorinated hydrocarbon	5000	6000
fensulfothion	Dasanit	organic phosphate	2.2	30
carbofuran	Furadan	carbamate	11	10,200
mexacarbate	Zectran	carbamate	67 - 155	1000 - 4000
malathion	Cythion	organic phosphate	1375	4444

Table 6-5. Acute Oral and Dermal LD_{50} Values of Herbicides and Growth Regulators

Common Name	Trade Name	LD_{50} Oral	LD_{50} Dermal
bromoxynil	Buctril	160 - 260	3660
amitrole	Amitrol-T	5000 - 15,000	10,000
atrazine	AAtrex	3080	10,200
benefin	Balan	10,000	(a)
bensulide	Betasan, Pre San	770	3950
cacodylic acid	Phytar 560	830	(b)
2,4-D	Various	375 - 800	800 - 1500
dalapon	Dowpon	7570	(c)
DCPA	Dacthal	3000	10,000
dicamba	Banvel	1029	(d)
diquat	Ortho Diquat	230	400
MCPP or mecoprop	Various	930	(e)
glyphosate	Roundup	4900	7940
paraquat	Ortho Paraquat	12.0	480
siduron	Tupersan	7500	(f)
silvex (2,4,5-TP)	Various	650	(g)
terbutol	Azak	34,000	10,250
MSMA	Daconate	1800	Unknown
chlorflurenol	Maintain CF 125	6400	Unknown
maleic hydrazide	Various	6951	Unknown

(a) No apparent toxicity to skin.

(b) Essentially nonirritating to the skin.

(c) Moderate irritation, not absorbed through the skin in toxic amounts.

(d) Very mild irritation on the skin; no evidence of systemic toxicity from percutaneous absorption.

(e) Poisoning by skin contact is very unlikely.

(f) Mild irritation on the skin.

(g) May cause skin irritation.

Table 6-6. Acute Oral and Dermal *LD*$_{50}$ Values of Fungicides

Common Name	Trade Name	*LD*$_{50}$	
		Oral	Dermal
benomyl	Benlate, Tersan 1991	9500	(L)a
	Bordeaux	300	1000
chloroneb	Demosan; Tersan SP	11,000	5000
chlorothalonil	Bravo, Deconil 2787, Exotherm	3750	10,000
captan	Captan, Orthocide	9,000 - 15,000	(L)a
cycloheximide	Actidione	1.8 - 2.5 - 133	(S)b
	Dexon	60	(M)c
	Dyrene	2710	n.a. (M)c
dinocap	Karathane	980 - 1190	9400
maneb	Manzate; Dithane; M-22; Tersan LSR; Fore	6,750 - 7,500	1000
PCNB	Terraclor	1,650 - 2,000	(M)c
thiabendazole	Mertect, Tobaz	3330	(L)a
zinc-ion maneb	Dithane M-45; Manzate 200	8000	8000
zineb	Parzate C, Ortho Zineb	5200	1000
thiram	Thylate, Tersan 75, Arasan	375 - 1000	2000
cadmium-containing compounds	Cadminate, Caddy	660	(M)c
phenyl mercuric acetate	PMA, Scutal	60	(M)
ETMCTD	Terrazole, Koban, Truban	2000	(L)
thiophanate ethyl	Cleary 3336, Topsin 50 W	7,000 - 15,000	15,000
thiophanate methyl	Fungo, Topsin M	7000	10,000
carboxin	Vitavax	3820	8000

a Little or no reaction at the dosages checked.

b Severe reaction at the dosages checked.

c Mild reaction at the dosages checked.

exhibit c

SHOP RULES - PESTICIDE APPLICATION

A. Equipment

1. Boots: Must be 10 to 12 inches high, and may be the type worn over the shoe or without shoes. When handling insecticides, boots are to be made of natural rubber or neoprene. May use other waterproof boots when insecticides are not in use. If boots obtain any leaks thus making them non-waterproof, they are to be replaced. Boot tops are not to be rolled down below the ten (10) inch level.

2. Gloves: Gloves are always to be waterproof and if not, they are to be discarded and replaced. No part of the glove, either inside or out, is to be absorbent cloth material. When handling insecticides, gloves are to be made of neoprene or rubber. Handling of any other pesticide may be done with other waterproof gloves.

3. Clothes: May be either disposable or washable type. Washable clothes must be laundered and disposable coveralls must be discarded when they become soiled or contaminated with pesticides.

4. Goggles: Protective plastic goggles or face shield attached to headgear to prevent contamination of eyes by splash.

5. Headgear: Hardhat with washable non-absorbent exterior surface or other waterproof headgear.

6. Inhalation Protection: A disposable dust mask or disposable cartridge respirator is to be used with powder insecticides. Respirator is to be furnished with acceptable filters for respective pesticide in use.

All above items are to be supplied by the University except Item 3.

B. Tank Fill Procedure

1. Filling with insecticides requires the following equipment to be worn:

    a. Goggles
    b. Headgear
    c. Boots
    d. Gloves
    e. Inhalation mask with powder insecticides

2. Filling with fertilizers only requires the following equipment to be worn:

    a. Inhalation mask with powder fertilizers

C. Spraying and/or Spreading

1. With insecticides requires the following equipment to be worn:
    a. Boots
    b. Gloves
    c. Headgear
2. Without insecticides requires the following equipment to be worn:
    a. Boots
    b. Gloves - optional

D. Pesticide Fill Area Regulations

1. No smoking, drinking, or eating is allowed in pesticide fill area.
2. Drips, puddles, and spills are to be absorbed and cleaned up immediately after occurrence.
3. Pesticide measuring containers are to be rinsed and wash disposed in tank after use.

E. Other Pesticide Safety Regulations

1. Each employee must thoroughly wash with an alkaline base soap and water after a pesticide. Alkaline base soap is to be supplied by OSU.
2. Use of leaky guns or other leaky equipment must be terminated and repaired before further use.
3. When working on equipment that could pose possible pesticide solution contact, i.e. dilute or concentrated, protective gear is to be worn to avoid such skin contact.
4. Each tanker is to carry alkaline soap for washing if insecticides are being used.
5. No one is permitted to spray pesticides, spread dry materials containing pesticides, or in any way handle pesticides if:
    a. The individual has severe dermatitis.
    b. The individual has sizable cuts, scratches, or bruises. Small cuts, scratches, and bruises must be thoroughly protected before handling pesticides in any manner. Band-aid coverage is not sufficient.
6. Each employee must report to work with clean clothing each day.

(E) 7. Waterproof boots must be worn during truck wash procedures.

8. Boots or shoes must be worn at all times.

F. Sanitary Procedures: The following Sanitary Procedures will reduce the possibility of pesticide exposure:

1. Alter spray pattern to keep spray off feet and legs.

2. After exposure to pesticides, wash thoroughly with an alkaline base soap and water before eating, smoking, or using restrooms.

3. Wash clothes exposed to pesticides with an alkaline base soap rather than detergents. Soaps are more effective than detergents for removing pesticides. (Examples of alkaline base soaps are Ivory, Castile, and Instant Fels.) Wash contaminated clothes separately from other clothing.

4. While spraying or spreading pesticides, avoid wiping the face or other skin surfaces with hands and arms.

5. Remove gloves exposed to pesticides in a manner to avoid skin contact with the outside of the glove.

6. Be careful not to contaminate the inside of gloves with pesticides. If the inside of the gloves become contaminated, discard them. Wash the outside of gloves with soap and water daily or more frequently if they become contaminated.

7. Shower as soon as possible at the end of the day, and if you were exposed to pesticides, use an alkaline base soap rather than detergents.

DAR/dee

REQUESTING AGENCY

OHIO STATE UNVIERSITY
0479

CLC LABS

1046 CRUPPER AVE.
COLUMBUS, OHIO 43229
(614) 888-1663
LABORATORY LICENSE #-34-1088

DATE DRAWN--- 08/04
DATE RECEIVED 08/05/81
DATE TESTED-- 08/05/81
REPORT DATE-- 08/05/81

CHOLINESTERASE TEST REPORT

LAB #	EMP #	NAME	A/S	DPH/HR.	SAMPLE TYPE	ASSAY TYPE	RESULT
2073	NONE	TWINE TONY		0.89	GOOD PLASMA	PRODUCTION	SATISFACTORY
2074	NONE	JONES KEITH H.		0.95	GOOD PLASMA	PRODUCTION	SATISFACTORY
2075	NONE	HOWARD DARRELL		1.19	GOOD PLASMA	PRODUCTION	SATISFACTORY
2076	NONE	MAYNARD DAVID		1.36	GOOD PLASMA	PRODUCTION	SATISFACTORY
2077	NONE	MEAD LISA		1.12	GOOD PLASMA	PRODUCTION	SATISFACTORY
2078	NONE	REYNOLDS ROB K.		1.09	GOOD PLASMA	PRODUCTION	SATISFACTORY
2079	NONE	VONVILLE PHIL E.		1.14	GOOD PLASMA	PRODUCTION	SATISFACTORY

REFERENCE RANGE FOR PLASMA IS .32 TO 1.82 DPH/HR
REFERENCE RANGE FOR RED CELL IS .37 TO 1.03 DPH/HR

106

* INDICATES LOW, BELOW NORMAL, OR A 40% DROP FROM PREVIOUS PLASMA VALUE

SAMPLES RECEIVED MORE THAN 4 DAYS AFTER DRAWN MAY HAVE INACCURATELY HIGH RESULTS AND WILL NOT BE POSTED TO THE PERMANENT FILE

A/S = AGE/SEX
DPH/HR = DELTA PH/HR

TOXICOLOGIST DATE 8/06/81

M. Ligman-Harty /KB

exhibit d

"d" pg. 1 of 1

Asbestos Assessment and Control
Microfibers/Macroproblems

By John Hoogakker
Rockford College

Abstract

This paper will address the logistics of implementing a competent asbestos assessment program for educational facilities. The current state of United States E.P.A. recommendations, in particular the asbestos assessment algorithm, will be described. Operational alternatives relative to the algorithm's "exposure number" will be reviewed and their costs projected.

Introduction

What is it? Asbestos is a naturally occurring group of minerals composed of various forms of magnesium silicate. These minerals are fibrous, non-combustible, flexible, strong, electrically and thermally insulative and durable. Asbestos ore can be milled into long parallel fibers.

Ninety percent of the asbestos used in the United States is of the "Chrysotile" type sometimes known as "white asbestos". This mineral is mined in Canada. Also in use are "Amosite" or brown asbestos and "Crocidolite" or blue asbestos, both mined primarily in South Africa. Other types which may appear but are less desirable due to inferior fibrous strength are "Anthophyllite", "Tremolite" and "Actinolite".

Uses

Use of asbestos began in the 1880s as thermal insulation for steam engines. Over three thousand common uses now exist for the material with approximately 900,000 tons used in the U. S. annually. Fortunately, 85 to 92 percent of that amount is employed in a way that effectively immobilizes fibers within a strong binding material. Fibers can, however, be liberated during grinding, sanding or cutting. The remaining 8 to 15 percent have been used in products where dissemination of fibers will cause concern. Insulative, acoustic or decorative applications of asbestos containing materials pose the most serious exposure problems, mostly through products that have been sprayed on for these purposes.

Health Effects

Asbestos is the granddaddy of identifiable carcinogens. Dr. Irving J. Selikoff and his associates conducted exhaustive research in the 1960s on the relationship between lung cancer and asbestos exposure. As supported by other researchers, a linear dose-response relationship between the two is accepted as a fact of medical science. The long serpentine fibers of the chrysotile type are most commonly implicated here.

Mesothelioma is another more rare form of cancer which affects the linings of the body cavities containing the respiratory and abdominal organs. This disease is nearly always fatal within two years and is solely the result of asbestos exposure - most often involving the crocidolite type of extremely small fibers. An important aspect of this disease is the extremely long latency period of from fifteen to forty years. Also particular to mesothelioma is its association with apparently low levels of exposure, that is, exposure of a non-occupational type.

A third disease associated with exposure is Asbestosis. Like "Black Lung" disease, Asbestosis is a chronic non-cancerous disease characterized by a hardening and thickening of lung tissue occurring as tissues attempt to minimize the irritation from the fibers. This disease exists in various degrees from relatively minor to terminal.

A final word on health effects. There are a number of factors that modify the risk of asbestos-induced disease. These include age and smoking. Children are more susceptible to contamination because of their active nature and potential for surviving a long latency period. Smokers who are contaminated run a risk of lung cancer ninety times greater than non-smokers who are not exposed and the combined effects of smoking and exposure exceed the sum of their separate effects.

Legal Status

As medical evidence grew, asbestos became the subject of the first OSHA standard in 1970. Having undergone several revisions, this standard remains the only asbestos exposure regulation with the force of law. This standard establishes an 8-hour time-weighted average of two fibers greater than 5 microns in diameter per 5 cubic centimeters of air. This standard relies on air sampling which is currently considered to be of questionable value.

In 1973, U.S.E.P.A. banned spray application of insulating of fireproofing materials containing more than one percent asbestos by weight. Decorative uses of sprayed material continued until prohibited in 1977.

In March 1978, the U.S.E.P.A. issued "a guidance document" relative to sprayed asbestos in buildings. This was followed in March 1979 by a document relative to school buildings in particular. Support documents relative to health effects and economic impact followed which help complete a fairly clear and concise set of "recommendations" which at this time is merely that.

In 1981, Congress designated the Department of Education to deal with assessing the problem of exposure in schools and to issue grant money for funding assessments. To date this program remains unfunded. Indeed the future of the Department of Education is somewhat in doubt, much less its unfunded programs.

Some government officials look for an act requiring assessment activities for all public school buildings housing grades K thru 12, in 1982. I do not. Even though the legislation may not be enacted, and it probably will not apply to higher education if it is, asbestos exposure has become a national environmental issue. College and university administrators should be alert for pressures from particular groups, i.e., students, faculty, trustees and public interest groups, and from personal conscience, to begin to mitigate any asbestos exposure hazard which might exist at their institutions.

Exposure Assessment

Returning to our discussion of the basic E. P. A. guidance documents, we may note the inclusion of an "assessment algorithm" in late 1979. This algorithm considers a number of factors in a mathematical relationship which yields a final "exposure number" for any particular surveyed location. This method has been widely accepted by environmental hygienists and state regulatory agencies as a valid assessment tool.

Visual Inspection. Prior to completion of the algorithm, a complete visual inspection of a facility is required to locate any suspect material. Such material would be fibrous and somewhat friable. Friability refers to the relative ease of pulverizing or otherwise breaking down the material with pressure from your hand.

Sampling. If such material exists and your building received application of this material prior to the imposition of the bans mentioned earlier, you must consider the possibility that some asbestos fibers exist in the material. Determination of this fact is accomplished by extracting a sample of the material and submitting it for professional laboratory analysis. Proper sampling techniques will be demonstrated in our film so it will suffice to mention here that protecting the sample taken and getting an accurate set of samples are the objectives of this operation. Use of a respirator is a must during sampling. The E.P.A. recommends that a sample be taken for every 5000 square feet of contiguous space, but good individual judgment may allow for fewer in some areas. Note that fastidious record-keeping is also important. A list of recommended sampling procedures is attached to this paper as Appendix "A".

Analysis. Your regional E.P.A. office can provide a list of laboratories which can analyze your samples, or you can refer to a recent list for region V attached as Appendix "B". The most basic procedure is called Polarized Light Microscopy. It may be valuable to duplicate every tenth sample, submitting the duplicate to an alternate lab, thus establishing a quality assurance control on the basic lab work. If samples are identified as positive (containing asbestos) you may wish to submit them to the next most sophisticated procedure, X-ray defraction, for verification.

When your analysis results have been received, you will know where friable material exists at your institution and which specific areas contain asbestos. For these areas you should complete the algorithm.

Assessment Algorithm. A sample Asbestos Survey Sheet comprises the next page (4). On it you (text continues third page hence)

ASBESTOS SURVEY SHEET

Bldg. ______________
Address ____________________
Total Sq. Ft. ______________

Date ____________________
Max. Enroll. Cap. ________
Present Enrollment _______

	1	2	3	4	5	6	6A	7	8	8A				
LOCATIONS	Condition of Material	Water Damage	Exposed Surface Area	Accessibility	Activity and Movement	Air Plenum or Direct Air Stream	Summation 1 through 6	Friability	Asbestos Content	7 x 8	Exposure Number 6A x 8A	Samples Taken ID Number	Sq. Ft. of Asbestos Surface	NOTES
Sample	2	0	4	1	1	0	8	2	2	4	32	001	925	cieling

- FINDINGS -

1. OFFICES AND LOUNGE AREAS

2. HALL, STAIRWAYS, EXITS

3. CLASSROOMS, LABORATORIES, WORKSHOPS

4. LIBRARY

5. WASHROOMS, LOCKER ROOMS, DRESSING ROOMS

6. RECREATIONAL ROOMS, GYMNASIUMS, SWIMMING POOLS

7. AUDITORIUMS, ASSEMBLY ROOMS

8. STORAGE SPACES, UTILITY ROOMS, PASSAGEWAYS

9. BOILER ROOMS, POWER PLANT

- REMARKS -

INSPECTOR

DATE

Summary - 8 Factors of Exposure Assessment

Factor 1. Condition of Material

a) No damage or deterioration. Score 0
b) Moderate damage or deterioration. Score 2
c) Severe damage or deterioration. Score 5

Factor 2. Water Damage

a) No water damage. Score 0
b) Minor water damage. Score 1
c) Moderate to major water damage. Score 2

Factor 3. Exposed Surface Area

a) No material is exposed. Score 0
b) Ten percent or less of the material is exposed. Score 1
c) More than 10 percent of the material is exposed. Score 4

Factor 4. Accessibility

a) Not accessible. Score 0
b) Rarely accessible. Score 1
c) Accessible. Score 4

Factor 5. Activity and Movement

a) Little or no activity. Score 0
b) Moderate activity. Score 1
c) High activity. Score 2

Factor 6. Air Plenum or Direct Air Stream

a) No air plenum or direct air stream. Score 0
b) Air plenum or direct air stream. Score 1.

Factor 7. Friability

a) Low friability. Score 1
b) Moderate friability. Score 2
c) High friability. Score 3

Factor 8. Asbestos Content

a) Trace amounts up to one percent. Score 0
b) More than one percent up to 50 percent. Score 2
c) More than 50 percent. Score 3

will notice spaces for the eight factors for which the inspector must assign values. The following page (5) outlines these factors, conditions which will exist for each factor and values for each condition. Let's imagine a sample location with the following conditions.

factor 1) Condition of Material
Moderate damage or deterioration — Score 2

factor 2) Water Damage
No water damage — Score 0

factor 3) Exposed Surface Area
More than ten percent exposed — Score 4

factor 4) Accessibility
Rarely accessible — Score 1

factor 5) Activity and Movement
Moderate — Score 1

factor 6) Air Plenum or Direct Air Stream
No — Score 0

Scores for Factors 1 thru 6 should be totaled

Sub-total A — 8

factor 7) Friability
Moderate — Score 2

factor 8) Asbestos Content
More than 1 percent up to 50 percent — Score 2

Scores for Factors 7 and 8 should be multiplied

Sub-total B — 4

Exposure Number = (Sub-total A) x (Sub-total B)
32 = 8 x 4

You will notice that we have used the algorithm and the values described to compute an exposure number of 32. Such calculations can take place across the survey sheet for each location listed.

Corrective Measures

E.P.A. guidance documents prescribe corrective measures in the following relation to exposure numbers.

exposure number	action
0-12	Deferred Action
10-50	Encapsulation
10-50	Enclosure
40 and over	Removal

A sample exposure number of 32 seems to rule out deferred action but not to require removal. What are the relative merits of all four of the actions listed.

Deferred action. Deterred action is appropriate when no substantial hazard currently exists. While there is no direct cost associated with this course, it will be necessary to regularly reinspect and reevaluate conditions to preclude worsening conditions. Special care must also be taken during maintenance operations.

Encapsulation. While encapsulation controls fiber release and is less expensive than removal, the actual asbestos material remains, and a management system of reinspection must be maintained. Appropriate use of encapsulants also relies on a reasonable level of integrity within the original (asbestos) material, and on relative inaccessibility. A current draft of products on the E. P. A. approved "Phase 11" list for encapsulants is attached as Appendix "C".

Enclosure. Enclosure shares the relative merits of encapsulation but may be more cost effective under certain conditions. With fiber "fall out" continuing above the barrier, future entry into that space will be difficult.

Removal. Removal eliminates the source of the asbestos hazard. It also eliminates the need for future management. However, do not overlook the possible necessity (and cost) of installing a replacement material to maintain fire rating or acoustic qualities.

Our sample exposure number of 32 suggests action on either encapsulation or enclosure. Careful consideration of these options must be made, and reference to the guidance documents in this regard is suggested.

Project Specification

The importance of issuing the proper specification for any asbestos containment project cannot be overemphasized. Any substandard operations during such a project may in fact worsen a problem rather than diminishing it by reintraining fibers in the air in great numbers, distributing them through previously uncontaminated areas, and/or leaving residual fibers on unprotected surfaces. Chapter 9 of the guidance document, Part 1, lists some of the particular concerns but a more detailed specification is actually necessary. Of those prepared by engineers qualified in this matter, I recommend the Guide Specification of Seagull Environmental Company of Harrods Creek, Ky.

Selection of an abatement contractor should be based on an agressive review of a firm's conformance with your type specification during a previous project. Such evidence of proper procedure must be considered along with proposed cost.

Projected Costs

The following cost estimate ranges for the State of Illinois may be of help in preparing budgets for assessment or control activity. Other states are listed by E.P.A. region along with estimates in the Economic Impact support document. Where costs for your facility might come in depend on such variables as geographic location, scale and physical peculiarities of areas to be dealt with.

Sample Analysis	- Polarized Light Microscopy	25.00 to 80.00 per sample
Sample Analysis	- X-ray Defraction	40.00 to 75.00 per sample
Deferred Action	- Cost of ongoing management program	
Encapsulation	- 2.02 to 3.75/sq. ft.	
Enclosure	- .69 to 4.25/sq. ft.	
Removal	- 1.55 to 5.00/sq. ft.	
Disposal	- .04 to 1.37/sq. ft.	
Insulation Replacement	- .70 to 1.25/sq. ft.	

Simple extensions of these figures to reflect the size of areas effected will establish a budgetary range for an entire asbestos project.

Conclusion

Where are we now? We still don't have a clear asbestos law. This may be good or bad. What we do have, unfortunately, is some contradiction within federal guidelines from different U. S. Government Departments, notably the E.P.A. and Department of Education. As so often happens, a technological lag between demand for a good encapsulant and its development has developed. The near future may bring a revolutionary product for treating asbestos fibers.

What should be done? At the least, administrators should select a method of assessment and identify the specific location and extent of asbestos hazards. What then? Maybe we should wait out the inter-department conflicts. Maybe we should wait out the technological lag. Is there a way that short term procedures can ease such waiting? Perhaps for some instances where severe exposure hazards do not demand emergency attention. Consider the elimination of dry dusting and mopping in questionable areas and increase the frequency of wet mopping. Consider an information system to alert your tradesmen to the hazards of particular kinds of work in certain areas. If such ideas have any merit in your situation, take them into account with all the other factors we discussed in determining what to do and when. Many institutions are a "leg up" on the asbestos situation with competent programs already functioning. Many more should be encouraged by this very brief overview to identify the scope of their dilemma and to begin planning their way out of it.

Acknowledgment

The author is indebted to the Winnebago County Health Department in Rockford, Illinois for their experience on "The Interdisciplinary Panel on Control of Asbestos" administered by that department and funded by NIOSH. The particular assistance and expertise of Mr. J. Maichle Bacon, Director, Environmental Health within that department, is gratefully acknowledged.

Bibliography

Attached as Appendix "D".

SAMPLING PROCEDURE

The following materials will be needed to conduct sampling during a visual inspection.

1. Respirator and filters
2. Sleeve protectors
3. Surfactant (amended water in spray bottle)
4. Small wide-mouth containers and labels
5. Central log book and inspection forms

List the buildings to inspect along with the square footage of each. By dividing the total square footage by 5000 square feet you determine the number of samples to be taken. To this number add an additional 20%.

Sampling is performed by following these procedures.

1. Material should be sampled when area is not in use.
2. Only those persons needed for sampling should be present.
3. Put on respirator - make sure filters are on, and protector sleeves.
4. Saturate surface to be sampled with a surfactant.
5. Use small wide-mouth container, hold away from your face, gently twist the open end into the material as far as it will go, remove sample container, close tightly and wipe off container with a damp cloth.
6. Label the container. This label should:
    - a. Identify school
    - b. Date sample was taken
    - c. Bear a unique identification (ID) number
7. Make a record of each sample in a notebook by noting:
    - a. Date sample was taken
    - b. Building where material was sampled
    - c. Area or room sampled
    - d. Sample ID number
    - e. Laboratory sample was submitted to for analysis.

8. Send the sample to an analytical laboratory for analysis.

Twenty percent of the samples (1 out of every 5) must be taken in duplicate and sent to two different laboratories. A comparison of the results will help determine the reliability of the laboratory work.

SAMPLE# DATE / /

BLDG.

SAMPLE# WD-01 DATE 12/12/80

BLDG. William Dennis School
Rockford Il

INTERIM LISTING OF COMMERCIAL LABORTORIES WITH CAPABILITIES FOR BULK ASBESTOS IDENTIFICATION

Ms. Fay Goldblatt
910 W. Clayton
Waukegan, Il. 60085
(312-249-1745)

American Can Company
Safety & Industrial Hygiene Lab
U.S. Highway 22
Union, New Jersey 07083
(201-686-4500)

Mr. M. A. Beg
American Microscopy Labortory
D. 3410 12th Avenue E.
Tuscaloosa, Alabama 35405
(205-349-2852)

Dr. W.C. Runnels
Analytical Center, Inc.
P.O. Box 15635
Houston, Texas 77020
(713-676-0141)

Ms. Sherry Merritt
Boeing Technology Services
9R-25
P.O. Box 3707
Seattle, Washington 98124
(206-237-2722)

Mr. Wayne Nakagawa
Brewer Analytical Labortories
311 Pacific Street
Honolulu, Hawaii 96810
(808-533-4411)

C.E.D., Inc.
Mr. Brig P. Tamayo
Environmental Microscopy International
135 West Cutting Blvd.
Richmond, California 94804
(415-234-3761)

Dr. Sam L. Casalina
Casalina Associates, Inc.
47-345 Mahakea Road
Kaneohe, Hawaii 96744
(808-239-6514)

Walter McCrone Associates
2820 S. Michigan Avenue
Chicago, Illinois 60616
842-7100

Mr. Bob Lieckfield
Clayton Environmental Consultants, Inc.
25711 Southfield Road
Southfield, Michigan 48075
(313-424-8860)

Mr. Jerome Krause
Colorado School of Mines
Research Institute
P.O. Box 112
Golden, Colorado 80401
(303-279-2581)

Dr. James Kirchner
Department of Geology
Illinois State University
Normal, Illinois 61761
(309-436-8922)

Mr. Alan W. Williams
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5206 Lindbergh Blvd.
W. Carollton, Ohio 45449
(513 -293-0025)

Mr. Mark Banister
Erie Testing Laboratories
2401 W. 26th Street
Erie, Pennsylvania 16506
(814-833-4790)

Mr. Bernard Erlin
Erlin Hime Associates
811 Skokie Blvd.
Northbrook, Illinois 60062
(312-272-7730)

Mr. Douglas Allenson
Herron Testing Laboratories
5405 Schaaf Road
Cleveland, Ohio 44131
(216-524-1450)

Mr. Al Gaynor
IIT Research Institute
10 West 35th Street
Chicago, Il. 60616
(312-567-4303)

Wausau Insurance Companies
Environmental Health Lab
2000 Westwood Drive
Wausau, Wisconsin 54401
715/845-5211

Appendix "B"

SEALANTS FOUND TO BE SATISFACTORY IN EPA EVALUATION AT BATTELLE-COLUMBUS LABORATORY (CONTRACT 68-03-2552 T2005)

BATTELLE CODE	COMPANY DESIGNATION	COMPANY	ADDRESS AND PHONE	
33775-4A	Decadex Firecheck	Pentagon Plastics U.S.A. Ltd.	7659C Fullerton Rd. Springfield, VA 22153 William F. Russek (703)569-5277	A**
33775-12B	Chemex Ultra	Chemix Chemical & Coating Co.	P.O. Box 5072 Tampa, FL 33675 Herbert F. Ross (813)248-6104	M***
33775-15C	Water-based Polyester	Western Coating Co.	P.O. Box 598 Oak Ridge Station Royal Oak Michigan 48073 Jack Sheets (313)588-3311	M
33775-19A	Cafco-Bond-Seal	United States Mineral Products Co.	Stanhope, New Jersey 07874 Mr. Frank Meuwirth (201)347-1200	A
33775-21A	554-21-1	H. B. Fuller Co.	Foster Products Div. P. O. Box 6255 Springhouse, PA 19477 Gene Secor (215)628-2600 or Toll Free 800/523/6017	A
33775-21B	Water-based XD-DG	Western Coating Co.	P.O. Box 598 Oak Ridge Station Royal Oak Michigan 48073 Jack Sheets (313)588-3311	M
33775-27A	#207 Special Sealer	Makus Development Corporation	P.O. Box 31 Mercer Island, WA 98040 Dan S. Makus (206)641-7373	M
33775-28A	Pyrokote-Mx	Development Services International	2021 K Street, N.W.,Suite 305 Washington, DC 20006 (202)331-7371	A
33775-29C	29-C Aqualoid 15-10	Essex Chemical Corporation	125 Blackstone Ave. Jamestown, NY 14701 (716) 621-8594	M
33775-30B	Asbestop BW225 Two Component	McGeddy International, Inc.	1043 Broadway W. Longbranch, NJ 07764 (201)229-5580	A

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BATTELLE CODE	COMPANY DESIGNATION	COMPANY	ADDRESS AND PHONE	
33775-42-A	Ocean Fire Retardant #666	Flame-Crete Co. of Canada, Inc.	40 Upton Road Scarborough, Ontario MIL-2B8 (614/741-4243)	A
33775-52-A	FRC-AES	FRC Composite Ltd.	1993 Leslie Street Don Mills, Ontario M3B2MC 613/741-4243	A
33775-52-B	FRC-REPC	FRC Composite Ltd.	(Same as above)	
33775-42-B	Metro Shield	Bertelson Assoc.,Inc.	8 Delwood Lane Tinton Falls, NJ 07724 201/542-6393	M
33775-41-C	C-1019	California Products Corporation	169 Waverly Street Cambridge, MA 02139	M
33775-43-A	1583	H. B. Fuller Co.	Foster Division P. O. Box 625 Springhouse, PA 19477 800/523-6017	M
33775-45-A	95-C-104	M. A. Bruder & Sons, Inc.	600 Reed Road P. O. Box 600 Broomall, PA 19008 215/353-5100	M
33775-45-C	95-W-100	M. A. Bruder & Sons, Inc.	(Same as above)	M
33775-47-A	L 241-43 Part A & B	Carboline Co.	350 Hanley Industrial Court St. Louis, MO 63144	M
33775-47-C	Super Chemseal	Chemray Coatings Corp.	150 Lincoln Blvd. Middlesex, NJ 08846	M
33775-48-A	Hygienscote	Acalor Chemical Construction	33 Kenhar Drive Weston, Ontario M9L1M9 416/749-2265	M
33775-50-A	TC1-750	Therma-Coustics	P. O. Box 190 Colton, CA 92324 714/783-0462	M
33775-51-A	25-2355	National Starch and Chemical Corp.	1164 N. Great Southwest Parkway Grand Prairie, TX 75050 214/647-9222	M
33775-53-A	Thermatek	Protek Manufacturing	520 South Muskego Ave. Milwaukee, WI 53208 414/6843-7689	M

BATTELLE CODE	COMPANY DESIGNATION	COMPANY	ADDRESS AND PHONE	
33775-31A	Ultra Lok 40-871	Cellin Manufacturing Inc.	P.O. Box 688 Springfield, VA 222150 (703)550-7277	A
33775-33C	Penqua 200	United Coatings	E. 1130 Sprague Ave. Spokane, WA 99202 (509)535-4131	M
* 33775-34C	Product # HI-6625-583-9	Habersham Industries, Inc.	5212 Industrial Court Smyrna, GA 30080 (404)351-7173	A
33775-35A	350-A-1 Asbestight 2000	Arpin Engineering, Inc.	1716 Melvill Street Oakhurst, NJ 97755 (201) 280-0400	A
33775-35B	Cable Coating 2-B	American Coatings Corp.	5235 N. Elston Chicago, IL 60630 (312)286-6610	A
33775-36B	Dust-set	Mateson Chemical Corp.	1025 Montgomery Ave. Philadelphia, PA 19125 (215)423-3200	M
* 33775-37A	662-583	Findley Adhesives Inc.	P.O. Box 3000 Elm Grove, WI 53122 (414)782-2250	M
33775-37C	Mono-Therm F-100	Mono-Therm Industries, Inc.	10819-120th Ave.,N.E. Kirklan, WA 98033 (800)426-8080	A
33775-42C	SK-13 Emulsion 360-0017	National Cellulose Corp.	12315 Robin Boulevard Houston, Texas 77045 Dan Kelly (713)433-6701	A
33775-13B-3	EX 64-3	Lehman Brothers Corp.	22 Halladay Street Jersey City, NJ 07304 Carmine Spatola (201) 434-1882	M

* Same Material

** Acceptable

*** Marginally Acceptable

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Physical Plant Management

PHOENIX '82
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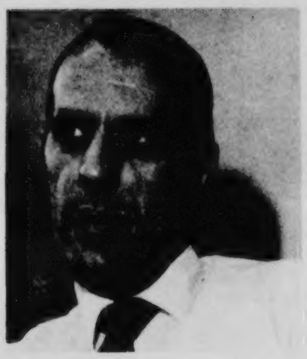

Quality Control/Project Management: A Must for Physical Plant Departments

By Michael J. Dwyer, Jr.
The University of Arkansas for Medical Sciences

Introduction

In this era of austere funding, the maintenance and engineering department must do all it can to increase productivity, while at the same time maintaining or even improving quality. In many institutions, maintenance departments are forming mini-construction crews to perform minor renovation and/or construction projects in order to both reduce costs and maintain tighter control over these projects. The need for individuals to perform the functions of project manager for these renovation and construction projects is fairly evident. However, the same individuals can be more than just project managers inspecting their own projects. They can also serve the role of quality control inspector for all maintenance activities. Inspecting work performed by other maintenance personnel without antagonizing the individuals being inspected is an extremely delicate task requiring proper training and understanding of the overall maintenance program.

It is also extremely important that the information gathered as a result of quality control type inspections is put to proper use by the department head. Not only can the department head evaluate the quality of work performed by his work force, but in many cases he will be able to rapidly detect inadequate training and/or lack of proper supervision by the foreman. When projects involve a number of different crafts and/or shops, there are many times when little items will not get completed due to lack of proper coordination. These items, although small in nature, tend to discredit the capabilities of the Physical Plant Department in general. Quality control inspections can readily identify these items and ensure that they are scheduled for completion in a timely manner. For total professionalism in the Physical Plant arena, we must ensure that some form of quality control is provided within the maintenance/engineering area.

Quality Control

The term quality control means many things to many people and has been practiced in one way or another for thousands of years. Without some form of quality control, the Great Pyramid of Egypt would never have been built, the Roman Forum would probably have collapsed, Christopher Columbus' ship might never have been launched, the Industrial Revolution might have flopped, and we surely would not have been able to put a man on the moon just a few years ago.

Quality control has been used in the manufacturing industry for years to ensure the production of quality products. Numerous mathematical formulas and computer simulations have been developed to increase the efficiency and improve the procedures used in many quality control systems. Statistical sampling has made a believer out of many production foremen who were confident that their product was flawless. In most instances, the final product, or some portion thereof, is evaluated against a given standard and those items that do not measure up to the standard are rejected.

Of course, the overall objective of any system is to reduce the product rejection rate to a minimum. The individual workers responsible for producing the items in question were generally not scrutinized directly. With the advent of nuclear weapons, the Department of Defense instituted a much more rigorous quality control program. Not only did they review the end product or the end result of a particular maintenance task, but they actually evaluated the individual performing a particular task and the manner in which he performed it. It was felt that although the end product or completed task might be satisfactory the procedures used might violate safety standards or include poor maintenance practices and ultimately lead to equipment malfunction and/or failures. In fact, the military quality control program went one step further and evaluated the procedures and manuals being used by the individuals performing the tasks.

Can portions of the type of quality control program described above be beneficial to a maintenance or Physical Plant Department in a large institution? As outlined earlier, in many institutions work is continually being performed by outside contractors in one form or the other. This work varies from major construction and/or renovation projects down to the installation of carpet in just a few rooms. Construction inspection or project management is really a form of quality control in that the work of the contractor is being monitored by a separate unit.

This same principle can easily be extended to work being performed by in-house personnel, as well as outside contractors. Although the thought of having in-house personnel evaluate the performance of their contemporaries may at first cause foremen and maintenance supervisors to rebel, a closer look at the possible benefits derived from such a program will dispel most apprehension and fears. An additional set of eyes that will provide feedback to the planning and/or scheduling section will prove invaluable and eventually increase overall department efficiency.

Quality control can also contribute to the overall training program of the maintenance department, as well as providing valuable input to an apprentice program where one exists. Quality control inspectors can also provide the point of contact for the monitoring of yearly maintenance contracts covering such areas as elevators, boilers, chillers, landscaping and other specialized areas. The individuals would already be familiar

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with inspection procedures as a result of their work in the construction and renovation area, and it would be relatively easy for them to adjust to performing follow-up inspections to determine if contract requirements are being met.

However, implementation of this type of quality control program must be carried out with extreme care and only after detailed planning coordination. The procedures to be followed by the quality control inspectors must be thoroughly understood by the inspectors and followed to the letter during the course of day-to-day operations. Extensive preparation is necessary because of the sensitivity and anxiety normally associated with the implementation of this type of program.

The individuals assigned to perform the duties of quality control inspectors must be selected with care. Besides being knowledgeable and experienced in their particular fields, they must possess the tact necessary to avoid conflicts with members of the work force. In most maintenance organizations the shop or crafts foremen or supervisors jealously guard their prerogative concerning the type and quality of work performed by their subordinates. The quality control program must strive to ensure that the foreman or supervisor, as well as the workers, do not feel threatened by the presence of quality control inspectors. Jealousy should be as far removed from the inspection program as possible. There will always be instances in which a conflict develops between the foreman or supervisor and the quality control section and in some cases, even a particular inspector. Without a doubt, the personality of the inspector can play a significant part in the overall success of the program and future relationship between the quality control section and the work force.

The procedures developed for the implementation of the quality control program should ensure that inspections are carried out after the fact as much as possible in order to avoid the inspectors and the workers being on the work site at the same time. Information and reports should flow upward within the quality control section culminating at the desk of the quality control department head. This individual should compile and summarize the results of the inspections eliminating items that may be considered petty and/or of minor significance to the program. This summary should then be forwarded to the Director of Physical Plant or Maintenance Department. It is then up to the Director to use the information as he sees fit, taking whatever action within his own department he deems appropriate.

By following this procedure, any direct contact between the quality control section and the work force is avoided and the chain of command within the Physical Plant Department can then be followed, passing the information down to the foremen or supervisors and on to the workers. Obviously, the workers will know a quality control program exists but, hopefully, they will never know which particular inspector reviewed their work. Of course, inspectors normally review work in their area of expertise; however, with proper cross-training it is possible to vary the type of job a particular inspector looks at so that the workers themselves will never know for sure when, if, or who actually reviewed their work.

A program of this nature must out of necessity generate a certain amount of records. Forms must be developed to record, as briefly as possible and as distinctly as possible, the results of the inspections. The identity of the inspectors must be indicated on the forms in case additional information is required. However, it might prove beneficial to assign numbers to the inspectors so that it is not readily apparent who did the inspecting. By rotating the numbers on some pre-determined basis, but knowing the date of the inspection and the inspection number, it is possible by using a master assignment list to determine the name of the inspector if necessary. Normally, this information is only available to the quality control director.

In addition, a method must be devised to ensure the type of inspection being conducted does not concentrate on a particular shop or craft or a particular type of job (i.e., all preventive maintenance work and no renovation work, etc.). A chart by craft that categorizes the type of inspection and the various types of work performed by that shop can prove extremely beneficial. When a problem develops in a given area, the quality control supervisor will be able to determine whether or not a sufficient number of inspections were being performed in that area. Proper adjustments can be made in the frequency and the type of inspections as necessary. A monthly summary report should be provided to the supervisor of a quality control section for his review and to make him aware of any significant problem areas, as well as the overall progress of the quality control program.

After reviewing the necessary steps that must be taken when planning a quality control program and the caution that must be observed in its implementation, the question of the overall benefits of such a program need discussion. At first glance many individuals believe that a quality control inspection system serves no other purpose than to point the finger at individuals who are not performing up to standard. Of course, poor performance will be identified, but the key is the reason for the poor performance, as well as its identification. Generally speaking, poor performance results from a lack of proper training on the part of supervisory personnel and at times lack of knowledge on the part of the foreman of his own people's capabilities and limitations. Of course, there will be those individuals who take no pride in their work and attempt to get by with a minimum amount of work. This type of individual needs to be identified and his efforts or lack thereof pointed out to appropriate supervisory personnel. There also may be instances where the overall quality and quantity of work by all members of a particular shop or craft appear to decline. This may result from poor leadership, low morale etc. and is an indication of a trend that must be identified and corrected as quickly as possible. Quantity of work may also be evaluated and used as a yardstick to measure scheduling effectiveness.

Quality control inspectors are also another set of eyes for the personnel performing the daily and weekly scheduling and can prove invaluable in identifying jobs that are not completed due to scheduling errors or lack of complete scheduling. These same inspectors can also provide an additional input into the scheduling process to aid in identifying job status and reporting phase completions so that other types of work may be scheduled (i.e., installation of carpet when painting is completed, etc.).

Quality control inspectors will also uncover problems that might not otherwise be detected. For example, if inspections are conducted prior to the completion of a job, poor workmanship and improper materials that might later be covered up by further construction can be identified. Generally speaking, individuals trained in quality control type work are more prone than other personnel to identify deficiencies or problem areas as they travel about the institution and report them to the appropriate scheduling activity.

Quality control is also extremely important in order to assess the validity of a preventive maintenance program. Not only are the inspectors able to assess the condition of the equipment maintained under the preventive maintenance program, but they also can assist in developing frequencies and types of inspections used in the program. There even have been cases where the inspectors have uncovered preventive maintenance tasks that were never actually accomplished but were signed off as completed by a worker on the particular work order.

Quality control definitely has a place in a maintenance organization. It is not something unique to the manufacturing area and if carefully planned and properly implemented, can prove an invaluable tool to management. Quality control inspectors do not have to become the ogres of the maintenance force; in fact, they can even prove beneficial to the individual workers. Rotating selected individuals from the shops through the quality control sections and back into the work force will greatly increase the overall efficiency of the maintenance department. During this period of rapidly rising costs, it may seem ludicrous to increase the size of the administrative overhead in any maintenance department; however, it can be demonstrated that the implementation of a quality control program will increase both the quality and quantity of maintenance output and, in fact, in the long run reduce overall maintenance costs.

Project Management

It is not uncommon for the Physical Plant Department to receive requests from other departments for minor remodeling and/or construction projects. These requests may be as simple as painting a particular area to renovating a lab into offices, upgrading patient care areas, remodeling office space for a new department head, constructing an addition to an existing building and in some cases, the construction of a brand new building. Depending on the size of the project and the inhouse capabilities, the work may be done by Physical Plant personnel, an outside contractor, or a combination of the two. Generally speaking, the greater amount of work done by the Physical Plant Department, the less the cost. However, in most instances, the Physical Plant Department is already overworked and cannot always spare the personnel needed to complete the requested project in a timely manner. In other instances, only certain crafts within the Physical Plant Department have a backlog or work and other shops are almost idle. In this situation, it may prove beneficial to have both the Physical Plant Department and outside contractor work on the same project.

Regardless of the method used, it is necessary that an overall project manager be assigned. Without someone to oversee the job, coordinate the work, handle the necessary details, as well as make decisions not included in the original plans, the project will in all likelihood experience a cost overrun, as well as a significant delay in completion. The University of Arkansas for Medical Sciences has elected to use a member of the Construction and Contract Management Office to act as a project manager for projects described above.

Initial cost estimates for new projects are prepared by a planner/estimator with the help of an assigned draftsman. Prior to formulating these estimates, the project manager from the Construction and Contract Management Office is assigned and he works with the estimator in preparing sketches, estimating costs and reviewing the project with the requester. After final approval, the estimator and the project manager work together in preparing work orders (if Physical Plant is to do the work) and/or plans and specifications if an outside contractor is involved. Once the work orders, plans and specifications are complete, total project responsibility is assigned to the project manager. It is then his responsibility to ensure a funding account is established, purchase orders are directed to a vendor and/or contractor, and plans and specifications are provided to the appropriate office if bidding is necessary. He also coordinates the preparation of work orders with the Physical Plant scheduling section.

Contact should be made with the requesting office to ensure they are made aware of estimated project start and completion dates and any special arrangements that might be necessary to facilitate the project, such as vacating the area. It has also been proven beneficial for the requesting department to assign a specific individual as the contact person for the project. This individual should have the authority to approve last minute changes and make the final acceptance inspection. The project manager then becomes the general contractor for the job handling and coordinating all work whether it is to be done by a contractor or in-house personnel. Through close coordination with all parties involved, the project manager can ensure a smooth flow of work with minimum delays and user disruption.

In numerous cases the user will request changes in project scope once the project has progressed to the point where final configurations are apparent. The project manager must also be cognizant of any changes in the job that result in additional costs while monitoring the project budget to ensure it remains within prescribed limits. If it becomes obvious that cost overruns are inevitable, the project manager must obtain additional funding through the user's representative as expeditously as possible. The project manager must also keep the requester's representative apprised of any delays in project completion. As the job progresses, the project manager will also perform the function of a quality control inspector for both contract work and in-house work. If this task is performed satisfactorily, it will eliminate a lengthy punch list of items to be completed at the end of the job and ensure a more professional approach to the overall project.

The project manager should conduct his final inspection with the requester's representative in order to ensure the work meets the standards and requirements of the requester. During the project and after its completion, it is the project manager's responsibility to approve all payment requests submitted for work done by outside contractors. As mentioned previously, he should also keep up with in-house Physical Plant costs in order to ensure total project costs do not exceed total available funds.

The final duty of the project manager is to fill out a project status report comparing estimated costs versus actual costs and planned time lines with actual time to complete the project. Deviation between actual and estimated costs and/or times should be explained by the project manager. This status report is a valuable management tool and can be used to avoid similar pitfalls, if any, in future projects.

If the project manager performs his role as the general contractor, quality control inspector and overall supervisor as outlined above, the project should be completed in a timely and efficient manner and reflect favorably on the professionalism of the Physical Plant Department.

Homemade Computerized Job Cost Control and Billing

By H. Thomas Gerrish
University of Maine at Orono

I am pleased to have the opportunity to share with you my experience in developing and implementing a computerized Job Cost Control and Billing System at the University of Maine at Orono. To begin this discussion, I will explain how I happened to become involved in this activity.

Early in the summer of 1979, I was given the assignment to do something about our out-dated and cumbersome system for maintaining cost control over our project work. At that point in time, our billing section was keeping labor and material costs on project work manually. As you can well appreciate, this system caused the clerical people of the billing section to spend a considerable portion of their time performing repetitious tasks. To make it even more difficult, we did not utilize the technique of establishing standard rates for each of our crafts; thus, we were guilty of executing a tremendous number of repetitive multiplications in order to accumulate our labor costs.

We experienced the following problems with our manual method for maintaining costs of individual projects.

1. It was an inefficient operation for the staff of the billing section.

2. We were not able to produce timely information regarding the number of manhours used by crafts to date on the active projects.

3. Also, we were not able to generate timely information concerning labor and material costs for a large number of projects.

4. Once the project was complete, we had trouble in preparing a prompt statement of charges for our customers.

5. The final statements of charges for projects were accurate, but lacked sufficient detail to satisfy many of our customers.

Simply stated, we were not able to exercise adequate managerial control over our projects in progress, nor were we producing detailed statements of charges that satisfied our customers once the work was complete. As you would expect, our campus reputation in the area of project management suffered due to these shortcomings.

To me, the answer to solving these job cost control and billing problems seemed simple - just computerize the whole operation! Even though I had limited previous experience in procuring data processing software programs for the automation of various Physical Plant operations, I felt confident that I would be able to obtain all the help I needed from the staff of the University of Maine System-Wide Computer Services Department. As a point of interest, the University System's central computer is located on our campus. With high expectations for a fast solution to job cost control and billing problems, I obtained permission from my boss to solicit the help of the system-wide computer services department to design a software program for this activity. So I arranged for a meeting with this department for the purpose of discussing my project with them.

As a result of this meeting, I learned that our system-wide computer services department would not be able to assist us directly in this project, because they were understaffed in the area of computer programmers. Some of you in this room probably have had a similar experience when trying to obtain programming support from your institution's central computer services department. Since the staff of the system-wide computer services was not able to offer direct programming support in the foreseeable future, they made two suggestions that I might want to try which were:

1. Try to find a suitable software program now being successfully used at some other college or university, for this would be the fastest way to achieve a computerized job cost control and billing system.

2. Check with software vendors such as IBM, etc., to determine if they have a software program which has already been developed that we could purchase.

Our central computer services staff had indicated during this meeting that they would not approve the purchase of a stand-alone mini-computer, including an appropriate software program, to solve our department's problems.

So I took their advice and visited some of the Northern New England colleges and universities in search of a software package for job cost control and billing that would meet the criteria that we had established for our proposed program and would be compatible with the equipment of our central computer. I did come across some existing programs that did have some possibilities, with alterations, of providing the detailed cost data and project management reports that we needed. Due to my lack of expertise in the technique of computer system analysis, I could not make a knowledgeable judgment as to whether or not these various software programs could be adapted to the University's Central Computer. However, these visitations did serve to familiarize me with the computerized job cost control and billing reports that these other institutions were generating.

Also, I followed up on the possibility of purchasing a software package (i.e., a canned program) from IBM. I was able to obtain a catalogue of their available software programs, but I was not able to arouse much interest in my project from the IBM sales department which specialized in this area. The best I could determine from reviewing IBM's software programs catalogue was that this company was planning to develop a program for this activity at some future date.

After searching for some eight (8) months for a software program which had already been developed, I came to the realization that I should abandon this effort. I asked myself, where do I go from here? By chance, I happened to be telling a staff member of the University's business office about my plight. He suggested that I hire a student who was studying computer programming to help me write a software program that could be used on the central computer. He further suggested that we start with one small aspect of what we wanted to computerize, and then gradually expand upon this program. Since I had come to a dead end on my other approaches to this problem, I decided to give this idea a try.

Around March of 1980, I started searching for a student who would be able to work for me part-time as a computer programmer. Shortly thereafter, a student who was already working for me on a special energy conservation information program expressed an interest in taking on this assignment. This student was a junior at our University majoring in Business Administration. His special academic interests were Accounting and Computer Programming. He seemed so interested in taking on the challenge of developing a program for us that I decided to reassign him to this project. His background in accounting procedures, as well as computer programming, proved to be very beneficial to the future success of this undertaking.

Now that I had a student programmer on board, it was time to plan our strategies for undertaking the project. After a few brainstorming sessions, we came up with the following plan:

1. The student and I would form a two man team for this project. He would do the computer programming and be the liaison person with the University System-Wide Computer Services Department. I would acquaint him with our current manual job cost control system. Also, I would be assisting him in developing the format for the various reports we would want our program to produce. During the time I served in my former position as Superintendent of Buildings and Trades, I had gained a great deal of experience in the area of job cost control and billing, and thus had accumulated some ideas of what an automated system for these activities should include.

2. We would procure our own terminal so we would not need to continually travel to the computer center to do our basic programming work.

3. We decided to break up the development of our total system into small logical packages so that we would not become overwhelmed by trying to accomplish too much too soon. The following sequence for system development was agreed upon:

(A) Craft man hours utilized recording and reporting program.
(B) Craft labor cost recording and reporting program.
(C) Materials and other services cost recording and reporting program.
(D) Total project cost recording and reporting program.
(E) Weekly comparison between estimated and actual costs on all active projects reporting program.

4. We established a tentative time table of having all these programs developed and fully tested by July of 1981.

5. When we actually went on line with these programs, we would still have the billing section keep the project cost records manually until all the bugs had been worked out of our new automated system.

6. We would start the training of a terminal operator for our program about three (3) months prior to the proposed start-up date of July 1, 1981.

7. We would need to prepare documentation of the computer programs for the new system, as well as a set of instructions for the terminal operator.

8. We would provide informational sessions for the project engineers, superintendents, engineering director, etc. on the progress of this project and advise them on how our new system would assist them on their project work. This proved to be very beneficial, because we received some valuable feedback which allowed us to produce a better over-all program for job cost control and billing.

Soon after this master plan had been formulated, we began to implement it. The student we hired to do the computer programming took to this assignment like a duck takes to water. Consequently, we were able to stay on our time schedule for the development of our program.

The first student worked for us about one year on the project, and then left our employment upon graduation. Once again, we were fortunate to be able to hire another well-qualified student who had just finished his sophomore year. This student was majoring in Math and Computer Science. We were able to achieve a period of over-lap between the two students so that the new one could be briefed on all aspects of the computerized program. This personnel change took place during June, and by July 1981, we were able to start handling the new projects with our system. We did not attempt to go back in time and pick up projects which were already well underway.

One of the first jobs we monitored was a large alteration project of some $68,000. The physical plant craft shops were forced to take on this project on a "crash program" basis, and, thus, we were very concerned that the estimated man hours would not be sufficient for doing this project on such a limited time work situation. This new computerized job cost control system turned out to be a very valuable tool in maintaining financial surveillance over this particular project. As a result of this, we gained the confidence and support of our physical plant staff for our computerized system.

At this time I would like to give an overview of how our "Home-Made Computerized Job Cost Control Billing" program operates and show you the reports it is capable of producing.

Let's start this part of the discussion by an explanation of the "LABOR CHARGE-BACK RATE TABLE", a copy of which you will find on the first page of the green and white lined handout. Please refer to this handout while its terms and contents are described:

Charge-back rates include a 17 percent mark-up - The charge-back rates for shop labor consist of the workers' hourly wage rate, plus a mark-up of 17 percent. We do not mark-up the hourly rate of our student workers or any other temporary employees working in our various shops, because they do not receive any of the fringe benefits our regular employees do.

Identification number - We assign each employee in our craft shops and in our grounds shop an identification number. When the workers fill out their daily time cards it is necessary for them to enter their assigned identification number in the upper left hand corner. As a point of interest, this is the only change we have introduced to the existing time card procedures which have been in effect for a number of years.

Name - The names of the workers which correspond to the assigned identification numbers in the previous column.

Shop - The name of the shop to which the individual worker is assigned. CA for carpenter shop, EL for electrical shop, PA for paint shop, PL for plumbing shop, ST for steamfitters shop, GR for grounds shop, and TC for temperature control shop.

Base rate - This is the hourly wage rate of a worker, i.e., payroll rate.

Regular charge-back rate - This is the base rate of pay of the worker plus, a 17 percent mark-up. This mark-up helps to cover the expense to our department for vacations and sick leave used by the employees, as well as providing a contribution to the cost of operating our work control center.

Overtime charge-back rate - This rate is 1½ times the regular charge-back rate and is applied in overtime situations.

The terminal operator for this program is responsible for maintenance of the charge-back rate schedule data base. This individual is informed by the personnel clerk of any changes that would effect it such as a pay increase given to a worker, or when a worker leaves or enters employment with a particular shop.

Now that we have an understanding of the labor charge-back rate table, let's see what a project manager would need to do to enter a new project into the computerized program for job costing and billing. Before a project can be entered into this system, the design should have been completed, the detailed cost estimate prepared, the budget officially approved, and the funding secured. With the preceding all accomplished, the project manager can now provide the terminal operator with a completed input data sheet necessary to enter the job into the system.

Please refer to the white sheet in the second handout for a copy of the "INPUT DATA ON NEW PROJECT FOR EDP SECTION." You will notice the actual data on a project that we have been working on has been entered. If changes are authorized after a project is started, a similar data sheet is prepared covering the changes and the terminal operator uses this sheet to update the project data base. During this overview, we will be following this same project throughout the various reports.

The only items of information requested on this form that need some clarification are the Account Number and the Type of project.

Account number - This item refers to the requesting department's account number. During the construction phase of the project, all costs are charged to a physical plant holding account. Upon completion of the project, the account of the requesting department is debited for the total accumulated expenses.

Type - We have established eight (8) separate categories for project work which are: Maintenance, Renovation, Alteration, New Construction, Energy Conservation, Handicapped, Safety Improvements, and Title IX.

Soon after the input data for our sample project - Install New Partition, Doors, Frames, etc. at the USDA Building - was entered into the system, the craft shops started working on this job. Employees' time cards and material bills flowed, on a daily basis, to our terminal operator, who in turn, entered the data into the system. We are using a CRT (Cathode Ray Tube) terminal which is directly on line with the University system central computer. The terminal operator uses a keyboard which is similar to that of a typewriter to enter the necessary project data. We believe we are much more efficient, because we are on-line with the computer and do not have to depend upon some other section of the University to handle our input data via a card punching operation.

If you would please turn again to the green and white lined hand out, you will find a report entitled "DEPARTMENT OF PHYSICAL PLANT - LABOR AND MATERIALS REPORT." This report contains the following sections: Detail of Physical Plant Labor, Summary of Physical Plant Labor, Detail of Materials and Other Services, Summary of Materials and Other Services, Detail of Off-campus Encumbrances, and Statement of Project Cost. Let's examine these one at a time.

Detail of Physical Plant labor - The information for this section of the report comes from the daily time cards. Each weekday morning, the terminal operator receives all the time cards for the previous day's activities and enters this information into the program's data base. To accomplish this, the operator enters the job number, the employees I.D. number, the date, and the number of hours worked. Illustrated on this section of the handout is the shop labor hours and cost by employees charged to our sample project - Install New Partition, Doors, Frames, etc.

Summary of Physical Plant labor - As the title suggests, this section of the report summarizes the labor hours and cost by individual shop. We can see the summary of Physical Plant labor for our sample project in this portion of the handout.

Detail of materials and other services - The information for this area of the report comes from copies of bills from the University's stockroom and from off-campus materials/services vendors. Again, it is one of the duties of the terminal operator to enter this information into the data base of the system. This type of information is entered soon after it has been received by the operator. The materials used on our sample project are listed on the handout.

Summary of materials and other services - This section of the report summarizes the materials and other services by individual shops. Also, in case the project manager has ordered some material or a special service not chargeable to a shop, it is listed as a charge to the project manager. Turning to our handout again we can see the summary of materials and other services for our sample project.

Detail of off-campus encumbrances - This section of the report provides the project manager, as well as the billing section, information concerning the dollar value of off-campus purchases to which we are committed. Once the bill for an off-campus purchase has been approved for payment, the encumbrance for this item is cleared. Any off-campus encumbrances for our sample project have been relieved.

UMO Department of Physical Plant - Statement of project cost - This section of the report provides a statement of project cost and is used as a cover sheet when we send the customer the other labor and materials cost reports at the conclusion of the project. You will find a statement of project cost for our sample project in the handout.

All the sections of the labor and materials report which we have just discussed are primarily for project billing purposes. These reports can be printed for use by the project manager at any time during the construction phase of an active project. This report is automatically printed at the conclusion of any project. We can view these reports on the screen of our CRT terminal if the project manager is in a hurry and does not need a hard copy of the information he is seeking.

The second report that the computerized program generates is the "WEEKLY PROJECT MANAGEMENT REPORT." This report is printed and distributed each Tuesday morning and includes cost information which was available through the previous Friday. The purpose of this report is to keep the project manager informed, on a weekly basis, of the man hours used, labor costs, and materials and other service costs compared to the estimates for these items. By having this information made available to him on a timely basis, he is better able to maintain financial control over a project during the construction phase. This report should serve as a good tool to help keep our department from over-running the budget for a particular project without even being aware of it. If a project appears to be headed for financial trouble, the project manager will be able to discuss possible alternatives with the customer so that the scope of the work can be kept within the budget or additional funds obtained to complete the job as originally planned. Turning to our handout once again, you will find the "WEEKLY PROJECT MANAGEMENT REPORT" for our sample project.

The third report which this computerized program generates is the "WEEKLY PROJECT SUMMARY REPORT." This report is also produced each Tuesday morning, and the cost information presented is complete through the previous Friday. The purpose of this report is to keep the management team, i.e., the three (3) superintendents, the Director of Engineering Services, the Director of Planning and the Director of the Department informed as to the financial status of all projects on a timely basis.

Please refer to the "WEEKLY PROJECT SUMMARY REPORT" in the green and white lined handout. Along with the sample project which has been highlighted for you, all the currently active projects are listed. As we study this report it can be seen how it assists the top management team in maintaining financial control over all the larger projects which are active on a timely basis. We were pleased when our Vice President for Finance and Administration recently asked to be on the distribution list for this report.

The fourth report which this computerized program generates is the "COMPLETED PROJECT BY TYPE DURING FISCAL YEAR ______." This report is printed on a monthly basis. The purpose of this report is to have an up-to-date list of projects which have been completed during the fiscal year that is in progress. It has been subdivided by category, i.e. Maintenance, Alteration/Renovation, New Construction, Energy Conservation, Handicapped, Safety Improvements and Title IX projects.

Please refer to the "COMPLETED PROJECTS BY TYPE DURING FISCAL YEAR 1981-82 REPORT" in your handout and I will review the main features of it with you.

The fifth and final report this computerized program generates is the "__________ SHOP LABOR PERFORMANCE FOR PROJECTS COMPLETED DURING FISCAL YEAR _____." This report is also printed on a monthly basis. The purpose of this report is to provide the individual shop supervisors with feedback as to how their unit performed on each completed project.

Please refer to the "CARPENTER SHOP LABOR PERFORMANCE FOR PROJECTS COMPLETED DURING FISCAL YEAR 1981-82" in your handout and I will review the main features of it with you. Also, this same type of report is generated for each of the other craft shops which are involved in this program.

We have plans for future expansion to our present programs for computerized job cost control and billing. These plans include:

1. A program to report individual costs of all the thousands of small projects, i.e., those that require less than 32 manhours to accomplish. At the present time, this activity is accomplished manually.

2. A program to compare engineered standard times to manhours actually used so that we could have a measure of our overall efficiency on small project work.

3. A program for backlog control, i.e. craft manhours required versus manhours available during a given period of time.

4. The addition of a high speed printer to go along with our CRT terminal. At the present time, we are somewhat limited by having to wait for the University System-Wide Computer Services to do the printing of our reports as it fits into their schedule of priorities.

CHARGE BACK RATE TABLE

****CHARGE BACK RATES INCLUDE A 17% MARK-UP****
****EXCEPT FOR TEMPORARIES****

ID. NO.	NAME	SHOP	BASE RATE	REGULAR CHARGE BACK RATE	OVERTIME CHARGE BACK RATE
1	WM TRACY	CA	5.44	6.36	9.54
2	AJ DAMIEN	CA	8.73	10.21	15.31
3	FJ BETTERS	CA	6.71	7.85	11.77
5	MM DAVIS	CA	5.18	6.06	9.09
6	RA DOUGHTY	CA	6.35	7.42	11.13
7	RH DOUGHTY	CA	8.10	9.48	14.20
8	FX DUPUIS	CA	7.29	8.53	12.78
9	WA EDGECOMB	CA	7.29	8.52	12.78
10	CH EMERSON	CA	5.61	6.56	9.84
11	CW GRINDLE	CA	6.71	7.85	11.77
	DUAL RATE		7.05	8.24	12.36
12	HA HARRIS	CA	8.10	9.47	14.20
13	RL KENNEY	CA	7.72	9.03	13.54
14	ED LEVASSEUR	CA	6.71	7.85	11.77
15	HL MCCROSSIN	CA	7.10	8.31	12.45
16	CD MOON	CA	5.18	6.06	9.09
17	RG MORIN	CA	7.29	8.52	12.78
18	B EAGER	CA	4.29	5.01	7.51
19	RW SWEDBERG	CA	6.92	8.10	12.13
20	GE WILLETT	CA	7.29	8.53	12.78
35	STUDENT-4.25	CA	4.25	4.25	6.37
37	PE ALBERT	EL	5.96	6.97	10.45
38	RN BOYINGTON	EL	7.29	8.52	12.78
39	TL BROOKS	EL	7.29	8.52	12.78
40	NG EMERSON	EL	6.35	7.42	11.13
41	DD FOGG	EL	7.29	8.52	12.78
42	A FOWLER	EL	7.29	8.53	12.78

	DUAL RATE		7.51	8.78	13.17
43	JA GLIDDEN	EL	6.51	7.62	11.41
	DUAL RATE		6.84	8.00	12.00
44	JJ HAMPEL	EL	8.18	9.57	14.35
45	KL LAMORE	EL	7.29	8.52	12.78
46	R MAXSIMIC	EL	7.29	8.52	12.78
47	GE MELVIN	EL	7.29	8.52	12.78
48	M MITCHELL	EL	7.29	8.52	12.78
49	H SOCTOMAH	EL	4.18	4.89	7.33
50	ED OAKES	EL	7.88	9.21	13.81
51	R PELLETIER	EL	8.07	9.44	14.16
52	RA RICHARDS	EL	7.51	8.78	13.17
53	NR ROSSIGNOL	EL	7.29	8.52	12.78
55	AW ST LOUIS	EL	5.23	6.11	9.16
56	LF ST LOUIS	EL	7.29	8.52	12.78
57	GF STORMANN	EL	7.29	8.52	12.78
58	RJ THOMAS	EL	6.39	7.47	11.20
59	WS TOZIER	EL	7.29	8.52	12.78
60	JJ VAILLANCOURT	EL	5.90	6.90	10.35
61	MC YORK	EL	7.29	8.53	12.78
	DUAL RATE		7.51	8.78	13.17
62	DW HERWEG	EL	8.51	9.95	14.92
63	DA LUCAS	EL	5.63	6.58	9.87
64	D HOLMES	EL	3.84	4.49	6.73
65	J MACOMBER	EL	5.71	6.68	10.02
66	S MOODY	EL	5.63	6.58	9.87
67	R MANNING	EL	5.08	5.94	8.91
76	STUDENT-4.87	EL	4.87	4.87	7.30
78	E HAMLIN	PA	4.18	4.89	7.33
79	DC BEAL	PA	5.55	6.49	9.73
	DUAL RATE		6.09	7.12	10.68
81	RR BRYANT	PA	7.29	8.53	12.78
82	K KENNEDY	PA	4.29	5.01	7.51
83	MC HOLMES	PA	6.74	7.88	11.82

84	W LITTLEFIELD	PA	6.74	7.88	11.82
85	AF MICHAUD	PA	6.74	7.88	11.82
86	EF MORRISON	PA	6.74	7.88	11.82
	DUAL RATE		7.10	8.30	12.45
87	BW SAWYER	PA	6.52	7.62	11.43
88	CJ ST LOUIS	PA	6.74	7.89	11.82
89	RD ST LOUIS	PA	6.74	7.89	11.82
90	R WOODCOCK	PA	5.90	6.90	10.35
	DUAL RATE		6.51	7.61	11.41
91	RW SWEDBERG	PA	8.07	9.44	14.16
92	RJ ARSENAULT	PA	5.08	5.94	8.91
	DUAL RATE		5.58	6.52	9.78
107	CH BARKER	PL	5.55	6.49	9.73
108	PD BICKFORD	PL	7.29	8.52	12.78
109	AD BOWMAN	PL	7.29	8.52	12.78
110	STUDENT-4.25	PL	4.25	4.25	6.37
111	DA DAY	PL	7.29	8.52	12.78
112	WI EDGECOMB	PL	8.18	9.57	14.35
113	TE FROST	PL	7.29	8.52	12.78
114	GW THAYER	PL	5.96	6.97	10.45
115	WE DEVEAU	PL	8.80	10.29	15.43
116	R DUNTON	PL	5.44	6.36	9.54
117	CH COFFEY	PL	5.96	6.97	10.45
131	RE BOOBER	ST	7.29	8.52	12.78
132	R FOGG	ST	5.63	6.58	9.87
133	JF DYER	ST	6.26	7.32	10.98
134	LI FOLTZ	ST	7.29	8.52	12.78
135	L GRAY	ST	5.89	6.89	10.33
137	AR NILES	ST	8.10	9.47	14.20
138	CH SMITH	ST	8.96	10.48	15.72
153	J ALLEN	GR	3.96	4.63	6.54
154	MA CORNETT	GR	4.46	5.21	7.81
155	G CROUSE	GR	4.56	5.33	7.99
156	SM CUST	GR	4.91	5.74	8.61

157	FA DUNN	GR	4.29	5.01	7.51
158	L KELLIHER	GR	3.84	4.49	6.73
159	PH FREY	GR	6.39	7.47	11.20
160	DD GRANT	GR	6.66	7.79	11.68
161	CP LANDRY	GR	5.19	6.07	9.10
162	CI MILLER	GR	7.04	8.23	12,34
163	R ST LOUIS	GR	4.88	5.70	8.55
164	JB STEWART	GR	4.91	5.74	8.61
165	GF THIBODEAU	GR	5.61	6.56	9.84
166	L TURTLOTT	GR	6.39	7.47	11.20
167	A WEYMOUTH	GR	5.55	6.49	9.73
168	HR WEYMOUTH	GR	6.39	7.47	11.20
169	S WEYMOUTH	GR	5.90	6.90	10.35
170	T GASAWAY	GR	3.96	4.63	6.94
171	RM WINSLOW	GR	5.07	5.93	8.89
172	DJ FOWLER	GR	8.45	9.88	14.82
173	J PETRIE	GR	3.84	4.49	6.73
174	M TRAFTON	GR	4.63	5.41	8.11
175	LG AUBIN	GR	3.84	4.49	6.73
176	P RICHARD	GR	4.19	4.90	7.35
177	R THURSTON	GR	3.96	4.63	6.94
178	A ST. SAVIOR	GR	5.00	5.85	8.77
179	W MASSEY	GR	4.63	5.41	8.11
180	R FOSS	GR	3.84	4.49	6.73
181	ST MCDONALD	GR	4.50	5.26	7.89
187	TEMP. EMPLOYEE	GR	3.35	3.91	5.86
188	FW ST LOUIS	TC	6.92	8.09	12.13
189	VE VOWLES	TC	6.21	7.26	10.89
	DUAL RATE		6.92	8.09	12.13
190	JA TREADWELL	TC	8.53	9.98	14.57
191	JW GRINDLE	TC	7.29	8.53	12.78
192	DJ BEASLEY	TC	5.90	6.90	10.35

Estimate Ref. No. E-22-82

Input Data on New Project for EDP Section

Project Control No. 2122-H Account No. 8-3-18724-551

Project Description USDA BUILDING-INSTALL NEW PARTITION, DOORS, FRAMES, ETC.

Project Manager JIM KEENE

Type:

☐ Maintenance
☐ Renovation
☑ Alteration
☐ New Construction
☐ Energy Conservation
☐ Handicapped
☐ Safety Improvement
☐ Title IX

	ESTIMATED			
Shop/Unit	Shop MH's	Shop Labor Cost	Materials Cost	Total Est. Cost
Carpenter	183	1464	1002	2466
Electrical	80	640	99	739
Paint	32	256	51	307
Plumbing				
Steamfitters				
Temp. Control	12	96	75	171
Grounds				
Project Manager				
Totals	307	2456	1227	3683

Amount of Contingency 736

Budget for Project 4419

Date of Work Order 12/4/81

.46

Revision No. 3

Date: 12/10/81

TO: EDP SECTION

DATA FOR PROJECT CHANGE ORDER

Project Control No. 2122 - H Account No. 8-3-18724-551

Project Title USDA BUILDING - INSTALL NEW PARTITIONS

Description of Change Order ADDITIONAL LIGHTING, INSTALLING LOUVRE IN DOOR AND CEILING REPAIR

Project Manager JIM KEENE Change Order No. 1

ESTIMATE COST OF CHANGE ORDER				
Shop/Unit	Shop Man-hours	Shop Labor Cost	Materials Cost	Total Est. Cost
Carpenters	32	288	100	388
Electricians	32	288	212	500
Painters				
Plumbers				
Steamfitters				
Temp. Control				
Grounds				
Project Manager				
Totals	64	576	312	888

Amount of Contingency 87

Budget for Change Order 975

Date for Change Order 3/17/82

REVISED INPUT DATA ON PROJECT UNDER CONSTRUCTION FOR EDP SECTION

Project Control No. 2122-H Estimate No. E-22-82

Project Description USDA BUILDING - INSTALL NEW PARTITION, DOORS, FRAMES, ETC.

Project Manager JIM KEENE Change Order No. 1

REVISED ESTIMATE				
Shop/Unit	Shop Man-hours	Shop Labor Cost (1)	Materials Cost (2)	Total Est. Cost
Carpenters	215	1752	1102	2854
Electricians	112	928	311	1239
Painters	32	256	51	307
Plumbers				
Steamfitters				
Temp. Control	12	96	75	171
Grounds				
Project Manager				
Totals	371	3032	1539	4571

Amount of Contingency 823

New Budget for Project 5394

Date of Original W.O. 12/4/81
(taken from White data sheet)

NOTES:
1. Shop labor estimate includes a 17% OH charge (does not include temporaries).
2. UMO Stock Room material estimate includes a 2% OH charge.

Date--August 19, 1981

GENERAL INFORMATION

Computer Type: IBM 4341 Memory: 8 Million byte

Terminal Type: IBM 3101-20

Language used in System: PL/I, EXEC, COBOL

Storage Facilities Used: 5 tapes

a. Current master file is rotated between 3 tapes.

b. Completed jobs file in rotated between 2 tapes, which alternate between "read only" and "write" status.

Notes:

The reason for alternating the tapes is to protect against losing master files.

Input is interactive - we use the IBM 3101 display terminal to update the current master file on a daily basis.

Completed jobs are transferred from the current master file to the completed jobs file monthly.

Output can be either (a) viewed on terminal or
(b) sent to a printer

All manipulation of programs and rotation of tapes are controlled by exec programs. This reduces the risk of operator error.

May, 1982

DEPARTMENT OF PHYSICAL PLANT

LABOR AND MATERIALS REPORT FROM 12/04/81 THROUGH 04/27/82

JOB # 2122H USDA-INSTALL NEW PARTITION,DOORS,FRAMES,SHEETROCK,ETC.   MANAGER: J KEENE   ACCOUNT NUMBER: 8-3-18724-551

DETAIL OF PHYSICAL PLANT LABOR

DATE	MECHANIC	SHOP	REGULAR LABOR HOURS	OVERTIME LABOR HOURS	REGULAR RATE	O.T. RATE	LABOR COST
12/08/81	JW GRINDLE	TC	3.00	.00	8.53	12.80	25.59
12/08/81	DJ BEASLEY	TC	3.00	.00	6.90	10.35	20.70
12/09/81	JW GRINDLE	TC	3.00	.00	8.53	12.80	25.59
12/09/81	DJ BEASLEY	TC	3.00	.00	6.90	10.35	20.70
01/14/82	EJ BETTERS	CA	2.00	.00	7.85	11.78	15.70
01/14/82	GE WILLETT	CA	2.00	.00	8.53	12.80	17.06
01/18/82	EJ BETTERS	CA	8.00	.00	7.85	11.78	62.80
01/18/82	CH EMERSON	CA	2.00	.00	6.56	9.84	13.12
01/18/82	GE WILLETT	CA	8.00	.00	8.53	12.80	68.24
01/18/82	JA GLIDDEN	EL	8.00	.00	7.62	11.43	60.96
01/18/82	MC YORK	EL	8.00	.00	8.53	12.80	68.24
01/19/82	EJ BETTERS	CA	8.00	.00	7.85	11.78	62.80
01/19/82	CH EMERSON	CA	2.00	.00	6.56	9.84	13.12
01/19/82	GE WILLETT	CA	8.00	.00	8.53	12.80	68.24
01/19/82	JA GLIDDEN	EL	8.00	.00	7.62	11.43	60.96
01/19/82	R PELLETIER	EL	1.00	.00	9.44	14.16	9.44
01/19/82	MC YORK	EL	7.00	.00	8.53	12.80	59.71
01/20/82	EJ BETTERS	CA	8.00	.00	7.85	11.78	62.80
01/20/82	CH EMERSON	CA	2.00	.00	6.56	9.84	13.12
01/20/82	GE WILLETT	CA	8.00	.00	8.53	12.80	68.24
01/20/82	JA GLIDDEN	EL	8.00	.00	7.62	11.43	60.96
01/20/82	MC YORK	EL	8.00	.00	8.53	12.80	68.24
01/21/82	EJ BETTERS	CA	8.00	.00	7.85	11.78	62.80
01/21/82	CH EMERSON	CA	2.00	.00	6.56	9.84	13.12
01/21/82	GE WILLETT	CA	8.00	.00	8.53	12.80	68.24
01/22/82	EJ BETTERS	CA	8.00	.00	7.85	11.78	62.80
01/22/82	CH EMERSON	CA	2.00	.00	6.56	9.84	13.12
01/22/82	HL MCCROSSIN	CA	7.00	.00	8.31	12.47	58.17
01/22/82	JA GLIDDEN	EL	8.00	.00	7.62	11.43	60.96
01/22/82	MC YORK	EL	8.00	.00	8.53	12.80	68.24
01/22/82	HR WEYMOUTH	GR	1.50	.00	7.48	11.22	11.22
01/22/82	S WEYMOUTH	GR	1.50	.00	6.90	10.35	10.35
01/22/82	LG AUBIN	GR	1.50	.00	4.49	6.74	6.74
01/22/82	P RICHARD	GR	1.50	.00	4.90	7.35	7.35
01/25/82	EJ BETTERS	CA	8.00	.00	7.85	11.78	62.80
01/25/82	CH EMERSON	CA	2.00	.00	6.56	9.84	13.12
01/25/82	GE WILLETT	CA	8.00	.00	8.53	12.80	68.24
01/25/82	JA GLIDDEN	EL	6.00	.00	7.62	11.43	45.72
01/26/82	WM TRACY	CA	1.00	.00	6.36	9.54	6.36
01/26/82	EJ BETTERS	CA	8.00	.00	7.85	11.78	62.80
01/26/82	CW GRINDLE	CA	1.00	.00	7.85	11.78	7.85
01/26/82	GE WILLETT	CA	8.00	.00	8.53	12.80	68.24
01/26/82	JA GLIDDEN	EL	7.00	.00	7.62	11.43	53.34
01/26/82	MC YORK	EL	7.00	.00	8.53	12.80	59.71
01/27/82	WM TRACY	CA	[illegible].50	.00	6.36	9.54	41.34

01/27/82	FJ BETTERS	CA	8.00	.00	7.85	11.78	62.80
01/27/82	RW SWEDBERG	CA	6.50	.00	8.10	12.15	52.65
01/27/82	JA GLIDDEN	EL	6.00	.00	7.62	11.43	45.72
01/28/82	FJ BETTERS	CA	4.00	.00	7.85	11.78	31.40
01/28/82	RW SWEDBERG	CA	2.00	.00	8.10	12.15	16.20
02/01/82	CI ST LOUIS	PA	4.00	.00	7.89	11.84	31.56
02/02/82	B WOODCOCK	PA	4.00	.00	6.90	10.35	27.60
02/05/82	RA DOUGHTY	CA	1.00	.00	7.43	11.15	7.43
02/05/82	RH DOUGHTY	CA	1.00	.00	9.48	14.22	9.48
02/05/82	FX DUPUIS	CA	2.00	.00	8.53	12.80	17.06
02/05/82	GE WILLETT	CA	2.00	.00	8.53	12.80	17.06
02/05/82	MC YORK	EL	1.00	.00	8.53	12.80	8.53
03/05/82	RR BRYANT	PA	1.50	.00	8.53	12.80	12.80
03/09/82	RR BRYANT	PA	.50	.00	8.53	12.80	4.27
03/26/82	A FOWLER	EL	8.00	.00	8.53	12.80	68.24
03/26/82	MC YORK	EL	8.00	.00	8.53	12.80	68.24
04/12/82	CH EMERSON	CA	1.00	.00	6.56	9.84	6.56
04/12/82	GE WILLETT	CA	2.00	.00	8.53	12.80	17.06
			300.00	.00			2383.62

SUMMARY OF PHYSICAL PLANT LABOR
FROM 12/04/81 THROUGH 04/27/82

SHOP	REGULAR LABOR HOURS	OVERTIME LABOR HOURS	TOTAL LABOR HOURS	LABOR COST
CARPENTER	165.00	.00	165.00	1311.94
ELECTRICAL	107.00	.00	107.00	867.21
PAINT	10.00	.00	10.00	76.23
PLUMBING	.00	.00	.00	.00
STEAMFITTERS	.00	.00	.00	.00
TEMPERATURE CONTROL	12.00	.00	12.00	92.58
GROUNDS	6.00	.00	6.00	35.66
	300.00	.00	300.00	2383.62

DETAIL OF MATERIALS AND OTHER SERVICES

DATE-OF-ENTRY	SHOP	DOCUMENT NUMBER	DATE	SUPPLIER	COST
12/14/81	TC	IDT023542	12/05/81	UMO STOCKROOM	1.02
12/14/81	TC	IDT023580	12/09/81	UMO STOCKROOM	63.21
01/18/82	CA	IDT029145	01/14/82	UMO STOCKROOM	36.68
01/20/82	FL	IDT028627	01/19/82	UMO STOCKROOM	10.20
01/20/82	CA	IDT028634	01/18/82	UMO STOCKROOM	8.32
01/20/82	FL	IDT028642	01/18/82	UMO STOCKROOM	2.73
01/21/82	CA	IDT029010	01/20/82	UMO STOCKROOM	50.43
01/21/82	CA	IDT029025	01/21/82	UMO STOCKROOM	37.70
01/21/82	CA	IDT029047	01/19/82	UMO STOCKROOM	75.40
01/26/82	CA	IDT029455	01/22/82	UMO STOCKROOM	8.32
01/26/82	CA	IDT029463	01/21/82	UMO STOCKROOM	15.12
01/26/82	CA	IDT029570	01/25/82	UMO STOCKROOM	303.96
01/27/82	CA	IDT029744	01/15/82	UMO STOCKROOM	462.67
01/27/82	CA	IDT029787	01/22/82	UMO STOCKROOM	4.05
01/27/82	FL	IDT029788	01/22/82	UMO STOCKROOM	23.12
01/27/82	CA	IDT029875	01/25/82	UMO STOCKROOM	14.05
01/27/82	EL	IDT029903	01/25/82	UMO STOCKROOM	18.85
01/27/82	FL	IDT029922	01/26/82	UMO STOCKROOM	1.69
01/29/82	CA	IDT030104	01/27/82	UMO STOCKROOM	6.65
01/29/82	CA	IDT030130	01/26/82	UMO STOCKROOM	1.36
02/02/82	CA	IDT030497	01/28/82	UMO STOCKROOM	8.51
02/02/82	CA	IDT030499	01/26/82	UMO STOCKROOM	90.58
02/02/82	CA	IDT030522	01/28/82	UMO STOCKROOM	154.22
02/02/82	CA	IDT030524	01/25/82	UMO STOCKROOM	102.82
02/04/82	FL	IDT031108	01/19/82	UMO STOCKROOM	97.26
02/04/82	EL	IDT031110	01/29/82	UMO STOCKROOM	46.75
02/04/82	CA	IDT031127	02/01/82	UMO STOCKROOM	116.24
03/04/82	CA	IDT034188	03/01/82	UMO STOCKROOM	87.90
03/15/82	CA	IDT037320	03/10/82	UMO STOCKROOM	31.82
03/22/82	CA	IDT038595	01/29/82	UMO STOCKROOM	7.64
03/22/82	CA	IDT038601	03/21/82	UMO STOCKROOM	13.10
03/30/82	FL	IDT039654	03/26/82	UMO STOCKROOM	5.21
03/30/82	FL	IDT039660	03/26/82	WRIGHT'S CARPETING & FLOORING COMPANY	50.25
03/30/82	CA	IDT039808	03/29/82	UMO STOCKROOM	201.06
04/14/82	CA	IDT042081	04/12/82	UMO STOCKROOM	24.48
					2183.37

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                         SUMMARY OF MATERIALS AND OTHER SERVICES
                            FROM 12/04/81 THROUGH 04/27/82
                                                                                   TOTAL MATERIALS &
  SHOP                  STOCKROOM MATERIALS         OTHER MATERIALS AND SERVICES     OTHER SERVICES
 CARPENTER                    1863.08                          .00                     1863.08
 ELECTRICAL                    205.81                        50.25                      256.06
 PAINT                            .00                          .00                         .00
 PLUMBING                         .00                          .00                         .00
 STEAMFITTERS                     .00                          .00                         .00
 TEMPERATURE CONTROL             64.23                          .00                       64.23
 GROUNDS                          .00                          .00                         .00
 PROJECT MANAGER                  .00                          .00                         .00
                         ---------------              ---------------                 --------
                              2133.12                        50.25                     2183.37


                              DETAIL OF OFF-CAMPUS ENCUMBRANCES
 DATE-OF-ENTRY      SHOP          P. O. NUMBER         DATE        SUPPLIER                               COST
                                                                                                     ---------
                                                                                                          0.00
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UMO DEPARTMENT OF PHYSICAL PLANT

STATEMENT OF PROJECT COST
FROM 12/04/81 THROUGH 04/27/82

JOB # 2122H ACCOUNT # 8-3-18724-551

USDA-INSTALL NEW PARTITION,DOORS,FRAMES,SHEETROCK,ETC.

*PROJECT MANAGER: J KEENE

PHYSICAL PLANT LABOR ------------------------------	$2383.62
MATERIALS & OTHER SERVICES------------------------------	$2183.37
TOTAL ------------------------------	$4566.99

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                              WEEKLY PROJECT MANAGEMENT REPORT THROUGH 04/27/82

JOB # 2122M   USDA-INSTALL NEW PARTITION,DOORS,FRAMES,SHEETROCK,ETC.
PROJECT MANAGER: J KEENE
SHOP UNIT              ESTIMATED            ACTUAL      PERCENT OF              ESTIMATED             ACTUAL      PERCENT OF
                         HOURS              HOURS       ESTIMATED HOURS         LABOR COST         LABOR COST     ESTIMATED LABOR
                                            USED        USED                                           .           COST EXPENDED
CARPENTER                 215              165.00                76.7                1752            1311.94           74.8
ELECTRICAL                112              107.00                95.5                 928             867.21           93.4
PAINT                      32               10.00                31.2                 256              76.23           29.7
PLUMBING                                      .00                  .0                                   .00             .0
STEAMFITTERS                                  .00                  .0                                   .00             .0
TEMPERATURE CONTROL        12               12.00               100.0                  96              92.58           96.4
GROUNDS                                      6.00                  .0                                 35.66             .0
                       ---------          ---------             -----           ---------          ----------        -----
                          371              300.00                80.8                3032            2383.62           78.6


SHOP UNIT              ESTIMATED MATERIAL   ACTUAL MATERIAL   PERCENT OF ESTIMATED    ESTIMATED          ACTUAL TOTAL  PERCENT OF ESTIMATED
                       AND OTHER SERVICES   AND OTHER         MATERIAL AND OTHER      TOTAL PROJECT      PROJECT COST     TOTAL PROJECT
                       COST                 SERVICES COST     SERVICES COST EXPENDED  COST                                COST EXPENDED
CARPENTER                1102              1863.08                169.0                2854            3175.02           111.2
ELECTRICAL                311               256.06                 82.3                1239            1123.27            90.6
PAINT                      51                  .00                   .0                 307              76.23            24.8
PLUMBING                                       .00                   .0                                    .00              .0
STEAMFITTERS                                   .00                   .0                                    .00              .0
TEMPERATURE CONTROL        75                64.23                 85.6                 171             156.81            91.7
GROUNDS                                        .00                   .0                                  35.66              .0
PROJECT MANAGER                                .00                   .0                                    .00              .0
                       ---------          ---------                -----           ---------          ----------         -----
                         1539              2183.37                141.8                4571            4566.99            99.9
                                          AMOUNT OF CONTINGENCY--------------- 823

                                          CURRENT BUDGET FOR PROJECT---------- $5394


 -------------------------------                 OFF CAMPUS ENCUMBRANCES------------------------        .00
| INITIAL BUDGET-----  4419    |
| NUMBER OF CHANGE ORDERS-1    |                 TOTAL FUNDS COMMITTED--------------------------  $4566.99
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                                                 PERCENT OF ESTIMATED PROJECT COST COMMITTED----       99.9

                                                 PERCENT OF BUDGET FOR PROJECT COMMITTED--------       84.6
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DEPARTMENT OF PHYSICAL PLANT

WEEKLY PROJECT SUMMARY REPORT THROUGH 04/29/82

JOB #	JOB DESCRIPTION	JOB STATUS	MGR	INITIAL BUDGET	CURRENT BUDGET	FUNDS COMMITTED	BALANCE	PERCENT COMMITTED
2068H	LITTLE HALL-INSTALL ENERGY MANAGEMENT SYSTEM	3	JT	13200	13200	8617.63	4582.37	65.2
2069H	AUBERT HALL-INSTALL ENERGY MANAGEMENT SYSTEM	3	JT	11220	11220	6967.45	4252.55	62.0
2073H	ENGLISH MATH-INSTALL ENERGY MANAGEMENT SYSTEM	3	JT	11940	11940	5799.69	6140.31	48.5
2074H	WELL COMMONS-INSTALL ENERGY MANAGEMENT SYSTEM	3	JT	9100	9100	6004.36	3095.64	65.9
2076H	SHINGLE WEED HOUSE & GARAGE	2	EM	4719	5602	1872.73	3729.27	33.4
2099H	STEWART COMMONS-WOMENS ROOM ACCESSIBILITY	3	RB	2600	2600	2332.30	267.70	89.7
2100H	STEWART COMMONS-MEN'S ROOM ACCESSIBILITY	3	RB	2600	2600	2319.49	280.51	89.2
2108H	HONORS CENTER-BUILD NEW HANDICAP RAMP,INSTALL DO	2	DN	1605	1605	512.10	1052.90	31.9
2109H	DARLING CENTER - INSTALL 2 OIL BURNERS	4	JT	1323	1323	1001.23	321.77	75.6
2111H	TELEPHONE LINE PROJECT	2	PD	37478	37478	2402.73	35075.27	6.4
*2122H	USDA-INSTALL NEW PARTITION,DOORS,FRAMES,SHEETROC	3	JK	5319	5394	4566.99	827.01	84.6
2129H	HAUCK AUDITORIUM - INSTALL ENERGY MANAGEMENT SYS	3	JT	8870	8870	6011.56	2858.44	67.7
2130H	MEMORIAL UNION - INSTALL ENERGY MANAGEMENT SYSTE	3	JT	7055	7055	3885.65	3169.35	55.0
2131H	GANNETT HALL - REHABILITATION TO EAST ENT. GRANI	2	JK	4500	4500	106.88	4393.12	2.3
2147H	BOARDMAN HALL - CHANGE STEAMTRAP CAGE UNITS	1	CS	2294	2294	561.68	1732.32	24.4
2148H	ALUMNI HALL - CHANGE STEAMTRAP CAGE UNITS	0	CS	1368	1368	.00	1368.00	.0
2150H	CROSSLAND HALL - CHANGE STEAMTRAP CAGE UNITS	1	CS	1006	1006	547.49	458.51	54.4
2151H	HITCHNER HALL - CHANGE STEAMTRAP CAGE UNITS	0	CS	779	779	.00	779.00	.0
2152H	STEVENS HALL (CTR, NO, SC) CHANGE STEAMTRAP CAGE	0	CS	4107	4107	.00	4107.00	.0
2153H	DEERING HALL - CHANGE STEAMTRAP CAGE UNITS	0	CS	4107	4107	.00	4107.00	.0
2154H	SHIBLES HALL - INSTALL ENERGY MANAGEMENT SYSTEM	3	JT	7059	7059	4468.83	2590.17	63.3
2155H	HILLTOP COMMONS - INSTALL ENERGY MANAGEMENT SYST	3	JT	8080	8080	4008.70	4071.30	49.6
2156H	FOGLER LIBRARY - INSTALL ENERGY MANAGEMENT SYSTE	1	JT	12810	12810	8403.87	4406.13	65.6
2158H	STODDER - REMOVAL OF WALL BETWEEN GAME ROOMS	3	JK	688	688	829.78	-141.78	120.6
2160H	ROGERS - REPLACE ELECT CABLE AGGIE ENG TO ROGERS	2	EM	3734	4134	2235.66	1898.34	54.0
2163H	GANNETT HALL - EXTEND WEIGHT ROOM 21'	4	JK	2853	4733	2307.26	2425.74	48.7
2164H	COLVIN HALL - INSTALL PERMANENT SHOWER IN R.D. A	3	EM	1010	1395	807.85	587.15	57.9
2167H	BENNETT - INSTALL HOOD, EXHAUST FAN & AIR DUCTS	0	JK	3580	3580	.00	3580.00	.0
2168H	AUBURN HALL - PAINT ROOMS 106 & 106A	4	EM	684	684	612.45	71.55	89.5
2169H	AUBURN HALL - PAINT 3 OFFICES (HOSKINS, PAGE'S &	4	EM	956	956	569.70	386.30	59.5
2172H	H.H.H. - INSTALL WATER COOLER 2ND & 3RD FLOOR	1	JK	980	1036	852.50	183.50	82.2
2173H	OAK HALL - INSTALL WATER COOLER 3RD & 4TH FLOOR-	1	JK	980	980	859.58	120.42	87.7
2174H	MEMORIAL UNION - 3RD FLOOR PAINT ROOM BY ELEV. &	5	EM	788	788	783.90	4.10	99.4
2175H	AROOSTOOK - RENOVATE DORM STORE IN BASEMENT (NO	3	JK	1132	1132	264.55	867.45	23.3
2176H	OXFORD HALL - TREAT HEALTH CLUB CEDAR	1	JM	691	1083	926.35	156.65	85.5
2177H	FIELDHOUSE LIGHTING - MISCELLANEOUS SUPPORT TO C	1	JM	581	581	82.19	498.81	14.1
2178H	KNOX HALL - DROP CEILING, LIGHTING IN BASEMENT P	4	JK	728	998	936.44	61.56	93.8
2179H	GARAGE - SERVICE STORAGE WALL	3	EM	5853	5853	3656.61	2196.39	62.4
2182H	UNION BUILDING - ADDITIONAL WORK TO CLASSROOM A	4	JK	880	880	912.55	-32.55	103.6
2184H	NUTTING HALL - INSTALL ENERGY MANAGEMENT SYSTEM	1	JT	8080	8080	1789.80	6290.20	22.1
2185H	BOARDMAN HALL - INSTALL ENERGY MANAGEMENT SYSTEM	0	JT	7060	7060	.00	7060.00	.0
2186H	HANCOCK HALL - INSTALL ENERGY MANAGEMENT SYSTEM	0	JT	7170	7170	.00	7170.00	.0
2187H	STEWART HALL - INSTALL ENERGY MANAGEMENT SYSTEM	0	JT	8080	8080	.00	8080.00	.0
2188H	YORK HALL - INSTALL ENERGY MANAGEMENT SYSTEM	1	JT	9560	9560	3490.30	6069.70	36.5
2189H	EAST ANNEX - PAINT 2ND FLOOR CORRIDOR	0	EM	1616	9560	.00	9560.00	.0
2191H	EAST ANNEX - PAINT ROOMS 208 & 208B	0	EM	961	961	.00	961.00	.0
2192H	MAPLES - PAINT ROOM 3 & 11	1	EM	892	1260	593.98	666.02	47.1
2193H	MAPLES - INSTALL VINYL SIDING, & REPAIRS TO WOOD	1	EM	21000	21000	1158.95	19841.05	5.5
2194H	FERNALD HALL - PAINT ROOMS 201 & 201F	1	EM	1617	1617	1219.82	397.18	75.4
2195H	OXFORD HALL - INSTALL COMPRESSOR FOR PNEUMATIC T	1	JT	802	802	639.96	162.04	79.7
2196H	NUTTING - HOOD INSTALLATION UP THRU ROOF	0	JK	1224	1224	.00	1224.00	.0
2197H	CHADBOURNE-AFTER COOLER TO CONTROL MOISTURE IN T	1	JT	1003	1003	1087.33	-84.33	108.4
2198H	SERVICE BLDG-INSULATE & SHEET ROCK WALLS OVER FI	1	EM	4230	4291	1523.51	2767.49	35.5
2199H	HILLTOP,STEWART,WELLS-POLICE CENTRAL RECEIVING S	1	EM	922	922	455.26	466.74	49.3

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2200H  USDA - PAINT ROOMS 202A - 214 - 205 & CONFERENCE      1   EM   3491   3859   1153.27   2705.73    29.8
2201H  KNOX-SUSPENDED CEILING, FLOURESCENT FIXTURES, CA      1   JK   5140   5140    205.80   4934.20     4.0
2202H  MURRAY - SHOWER IN BATHROOM, FLOOR REMOVAL & REP      1   JK   1140   1140      1.43   1138.57      .1
2203H  COBURN - ROOM 30 CEILING, LIGHTING, WALLS, FLOOR      1   JK   8631   8631    908.38   7722.62    10.5
2204H  WINSLOW HALL - REPAIRS TO WEST PARAPET WALL           1   EM   3600   3600     14.05   3585.95      .3
2205H  WINSLOW HALL - REPAIR TO EAST PARAPET WALL            1   EM   3000   3000    112.40   2887.60     3.7
2206H  FERNALD HALL - PAINT EAST STAIRWAY                    1   EM   1449   1449    338.70   1110.30    23.3
2207H  DEERING HALL - PAINT CONFERENCE ROOM & TWO CLASS      0   EM   1866   1866       .00   1866.00      .0
2208H  NORTH STEVENS - PAINT CORRIDOR -- WEST END            1   EM   1843   1843    121.17   1721.83     6.5
2209H  USDA - PAINT ROOM #219, 22[illegible], 222, 225       1   EM   1913   1913    158.94   1754.06     8.3
2210H  WEED PROPERTY - REMOVE COLLAPSE SECTION OF BARN       0   JK    900    900       .00    900.00      .0
2211H  HILLTOP COMMONS - CHANGE FLOURESCENT TO INCADESC      0   JK   2135   2135       .00   2135.00      .0
2212H  OAK HALL - HANNABIL HAMLIN HALL - INSTALL CONDUI      0   D    2075   2075       .00   2075.00      .0
2507H  BASEBALL FIELD-PROVIDE POWER TO FIELD FROM GYM        1   RB   3921   3921   4100.52   -179.52   104.5
2518H  BENNETT HALL - PARTITION MAIN ENTRANCE INTO HALL      1   RB   1839   2120   1503.16    616.84    70.9
2520H  NORTH STEVENS ROOM 11-CONSTRUCT OFFICE PARTITION      1   DN   8916   8916   5668.93   3247.07    63.5
2521H  MACHINE TOOL LAB - COMPLETE TIE-IN OF EQUIPMENT       2   DN   1850   1850    304.35   1545.65    16.4
75431  SHIBLES HALL BASEMENT, INSTALL WINDOW RM #35          1   DN    975    975    582.37    392.63    59.7
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       TOTAL                 72 PROJECTS                                 331521  114161.11  217359.88
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DEPARTMENT OF PHYSICAL PLANT

COMPLETED PROJECTS BY TYPE DURING FISCAL YEAR 1981-82 THROUGH 04/26/82

* DETAILED COMPUTER REPORTS NOT AVAILABLE

ALTERATION/RENOVATION PROJECTS

JOB #	JOB DESCRIPTION	PROJECT MANAGER	DATE COMPLETED	BUDGET	ACTUAL COST	PERFORMANCE (%)	
2046H	STEWART COMMONS TO COLVIN HALL - MOVE DISHWASHER	JK	08/20/81	950	1123.97	84.5	*
75844	HANNIBAL HAMLIN HALL- RENOVATE COSMETIC FEATURES	JM	09/09/81	20000	21364.00	93.6	*
75728	OAK HALL - CHANGE SPACE TO RD APT., REMOVE 1-FLR CORR. WAL	JM	09/10/81	25000	25322.00	98.7	*
2032H	COBURN HALL - RM 35, DROP CEILING, FORMICA COUNTER, LIGHTS	JK	09/17/81	1600	1802.53	88.7	*
2289A	U.S.D.A BLDG.-BUILD ROOM WITHIN ROOM 204	JK	09/30/81	1725	1221.81	141.1	
2011H	LORD HALL - RM 123 - CONSTRUCT WALL	JK	09/30/81	1200	1463.94	81.9	*
75729	ALUMNI HALL- RENOVATION TO BUSINESS OFFICE	JK	10/21/81	20107	20007.34	100.4	
2012H	LORD HALL - RM 175 - DOOR & SOUND PROOF PARTITION	JK	11/04/81	2700	2018.70	133.7	*
2072H	FOGLER-BUILD OFFICE PARTITIONS,INSTALL DOOR,FRAME,REC.	JM	11/04/81	2061	1137.08	181.2	
2045H	RAMS HORN - REMOVE AND INSTALL DISHWASHER	JK	11/10/81	940	532.07	176.6	*
2059H	CROSSLAND ALUMNI CTR.-CHANGE DARK ROOM INTO OFFICE.	JK	11/23/81	1322	1369.47	96.5	
75441	STEVENS RM 215 - 2 OFF.,LOWER CEILING, INSTALL TILES, ETC	JK	11/23/81	2500	925.45	270.1	
2060H	BOARDMAN-DIVIDE ROOM W/ PARTITION,DOOR,ECT. FOR COMP. ROOM	DN	12/07/81	1200	1039.90	115.3	
2087H	COBURN RM 21-NEW COUNTER TOP & VINYL SHEETROCK 2 WALLS,SIN	JK	12/08/81	1041	601.59	173.0	
2085H	YORK COMMONS-CONSTRUCT STORAGE AREA WITH DOOR,KEY IN KNOB.	JK	12/18/81	1118	1157.23	96.6	
2056H	BARROWS HALL-SUPPLY POWER PANEL & POWER FOR A/C'S & COMP.	DN	01/04/82	1344	729.89	184.1	
2095H	FOGLER LIBRARY-INSTALL ELEC. LINES FOR VALI-DINE SYS.	JK	01/04/82	1921	1891.36	101.5	
75303	STEWART COMMONS-NEW SERVING LINE IN COMMONS-IN HOUSE PART	JM	01/19/82	812	608.57	133.4	
2098H	CUMBERLAND-REPLACE LIGHT FIXTURES IN LOUNGE AREA	JK	01/26/82	1797	1662.19	108.1	
2107H	HONORS CENTER-PARTITION OFF AREA FOR OFFICES	JK	01/27/82	1210	1189.58	101.7	
2133H	MEMORIAL UNION ALTERATION OF HOLE IN WALL - GALLERY	JK	01/27/82	1020	1089.61	93.6	
2135H	GANNETT,KNOX HALL-REKEY ALL STUDENT ROOM LOCKS	JK	01/27/82	660	565.95	116.6	
2121H	ALUMNI HALL-CHANGE HEATING SYSTEM IN 3 SMALL OFFICES	JK	02/10/82	2633	1158.38	227.3	
2086H	ENGLISH MATH BLDG-CONSTRUCT 2 TEMP. OFFICES,4TH FLOOR	JK	02/19/82	1816	2527.71	71.8	
75438	SCIENTIFIC RESEARCH - LAND & WATER CENTER, STAIRWELL	DN	02/19/82	3700	3404.39	108.6	
2090H	PICS BLDG - BUILD SHELVES & INSTALL	JK	02/22/82	1182	1510.75	78.2	
2103H	STODDER COMMONS-RELOCATE BAKERY HOOD	JK	02/23/82	580	529.38	109.5	
2123H	AUBERT - RENOVATE ROOM 355 AS PER DRAWING	DN	02/23/82	1200	1255.75	95.5	
2512H	126 COLLEGE AVE - COMPLETION OF ORIGINAL PROJECT	DN	03/04/82	2139	2854.64	74.9	
2516H	AUBERT HALL - ROOM 365 RENOVATIONS	DN	03/08/82	3571	3701.99	96.4	
2514H	HAUCK-RENOVATION INTO 3 OFFICES	JM	03/18/82	8955	9305.68	96.2	
75727	CHILDREN'S STUDY CENTER - SHEEP SHED	DN	03/19/82	81900	83226.93	98.4	*
2084H	H.H.H - EXPANDED VERSION OF LAUNDRY RENOVATIONS	JM	03/24/82	2223	1991.15	111.6	
2127H	SERVICE BLDG - ALTERATION TO CONFERANCE ROOM	JK	03/26/82	1504	1387.37	108.4	
2263A	HITCHNER - S.S.HOOD; INSTALL OVER AUTOCLAVES-RM/249	JK	04/06/82	500	855.29	58.4	
2183H	LORD HALL - REMOVE OLD CARPET & INSTALL NEW IN BAND ROOM	JK	04/16/82	4283	2692.81	159.0	
	TOTAL 36 PROJECTS			208414	205226.00	101.5	

ENERGY CONSERVATION PROJECTS

JOB #	JOB DESCRIPTION	PROJECT MANAGER	DATE COMPLETED	BUDGET	ACTUAL COST	PERFORMANCE (%)
2136H	ALUMNI HALL - COMBINATION WINDOW	JK	03/29/82	1377	1342.49	102.5
	TOTAL 1 PROJECTS			1377	1342.49	102.5

HANDICAPPED PROJECTS

JOB #	JOB DESCRIPTION	PROJECT MANAGER	DATE COMPLETED	BUDGET	ACTUAL COST	PERFORMANCE (%)
2510H	YORK VILLAGE - APT. 22 HANDICAPPED ACCESSABILITY MODIF.	JM	03/15/82	500	186.51	268.0
	TOTAL 1 PROJECTS			500	186.51	268.0

MAINTENANCE PROJECTS

JOB #	JOB DESCRIPTION	PROJECT MANAGER	DATE COMPLETED	BUDGET	ACTUAL COST	PERFORMANCE (%)	
2005H	KENNEBEC HALL - TILE WORK. ESTIMATE 152-81	JK	07/31/81	2000	1832.28	109.1	*
2013H	BENNETT HALL - PAINT ROOMS 26 & 27	EM	08/03/81	883	771.81	114.4	*
2035H	UNIV. PARK - PAINT APT. 28A,33A,33B,35B,27E,27G.	JK	08/17/81	3480	4146.88	83.9	*
2054H	ALFOND ARENA - PAINT COACH & ASSIST. COACH'S OFFICE'S	JK	09/09/81	480	304.88	157.4	
2234A	FOGLER LIB.-ACC. MASONRY WATERPROOFING 2235A	EM	10/05/81	10858	8647.30	125.5	
2050H	MERRILL HALL P.M. ON TEMPERATURE CONTROLS & EQUIPMENT	JT	10/05/81	900	397.06	226.6	
2051H	DEERING HALL P.M. ON TEMPERATURE CONTROLS & EQUIPMENT	JT	10/05/81	900	865.28	104.0	
2049H	WINSLOW HALL P.M. ON TEMPERTURE CONTROLS & EQUIPMENT	JT	10/12/81	850	266.08	319.4	
2082H	ESTABROOKE HALL-REPLACE BATTERIES IN EMERGENCY LIGHTS.	JK	10/12/81	2636	1869.61	140.9	
2043H	GANNETT-REPAIR SE STAIRS ON GROUND FLOOR	JK	10/13/81	700	684.55	102.2	
2065H	PRESIDENT'S HOUSE-PAINT SUN PORCH	EM	10/13/81	1698	1711.50	99.2	
2079H	PRESIDENT'S HOUSE-PAINT LIVING ROOM	EM	10/14/81	950	700.42	135.6	
2055H	ALFOND ARENA - WIRE PUMPS IN COOLING TOWER	RM	10/15/81	2508	2115.77	118.5	
2052H	NUTTING HALL P.M. ON TEMPERATURE CONTROLS & EQUIPMENT	JT	10/28/81	850	375.34	226.4	
2053H	ELECTRIC LINES - PULL CABLE BETWEEN ANDRO. & CUMBERLAND	JK	11/03/81	14344	8617.27	166.4	
2067H	UNIV.PARK-INSTALL 1/4 TEMP GLASS ON SIDE LIGHT BY ENT.	FB	11/03/81	1723	1263.57	136.3	
2066H	AUBURN HALL-PAINT EX.,ROOF FASCIA,CVRHNG SOFFIT,CANOP,DOOR	EM	11/04/81	2382	2408.64	98.8	
2020H	ELECTRIC LINES - REPLACEMENT OF 15 STREET LIGHTS	JK	11/10/81	3000	3739.96	80.2	*
2093H	PRESIDENT'S HOUSE-PAINT GAME ROOM	EM	11/19/81	1267	1373.69	92.2	
2104H	LITTLE HALL-REPLACE 3RD FL CORRIDOR CEILING	EM	11/24/81	949	724.98	130.8	
2092H	ALUMNI HALL - MPBN - ETV - PAINT RESTROOMS	EM	11/30/81	508	392.13	129.5	
2070H	CUMBERLAND - REHABILITATION TO NORTH ENT. GRANITE STEPS	JK	12/04/81	7500	2806.78	267.2	
2078H	MURRAY HALL-CAULK WINDOWS ON EAST SIDE OF BLDG.	EM	12/08/81	1840	1928.30	95.4	
2110H	STODDER HALL PAINT NORTH LOUNGE HALLWAY	EM	12/18/81	2038	1953.38	104.3	
2061H	GRANDSTAND-PAINT LADIES BATHROOM,CHECK SIGNS,CHECK WINDOWS	JK	01/04/82	1122	1058.47	106.0	
2091H	CARIBOU HALL-INSTALL ENERGY MANAGEMENT SYSTEM	JT	01/04/82	580	85.82	675.8	
2125H	HOLMES HALL - CHANGE STEAMTRAPS	CS	01/04/82	717	339.28	211.3	
2094H	ALUMNI HALL - MPBN - PAINT MPBN RADIO OFFICE	EM	01/06/82	1916	1845.80	103.8	
2102H	ALUMNI HALL-PAINT PRESIDENT'S SECRETARY OFFICE	EM	01/06/82	633	393.26	160.9	
2116H	POLICE & SAFETY - REPLACE STAIRTREADS WITH 3/4 PLYWOOD	JK	01/06/82	809	560.36	144.3	
2128H	DEERING HALL - CHANGE LIGHTS IN LAB ROOM 3 TO FLUOSESCENT	JK	01/06/82	640	366.19	174.7	
2075H	MEMORIAL GYM-REPAIR CEILING IN MEN'S LOCKER ROOM	EM	01/11/82	960	724.25	132.5	
2117H	CHADBOURNE - PAINT ALL BATHROOM CEILINGS	JK	01/11/82	2754	1341.57	205.2	
2027H	BANGOR HALL BCC-PAINT HALLWAY INCL. CEILING,DOORWAYS,FRAME	EM	01/12/82	1670	2287.93	72.9	
2112H	CORBETT 4TH SOUTH-REPLACE 3 SHOWERS	JK	01/13/82	655	600.25	109.1	
2037H	AROOSTOOK-MAKE REPAIRS TO STUDENT ROOM LOCKS	JK	01/27/82	990	736.84	134.3	
2138H	SIGMA NU - INSTALL HEAT EXCHANGER FOR THE HOT WATER	DM	02/09/82	1153	551.67	209.0	
2083H	BCC BOOKSTORE-SECURE FR DOORS,INSTALL CENT POST	JK	02/10/82	727	681.90	106.6	

2118H	COBURN HALL - 2ND FLOOR STORAGE & OFFICE, PATCH & PAINT	EM	02/10/82	600	409.20	146.6
2058H	DUNN & CORBETT-REFURBISH H.W.TANK TO CODE FOR PRESSURE VES	RM	02/23/82	1600	558.80	286.3
2088H	STUDENT UNION BCC-INSTALL NEW LIGHTS IN KITCHEN.	JK	02/23/82	651	1057.03	61.5
2113H	CUMBERLAND,GANNETT-VENT LAUNDRY DRYERS	JK	02/23/82	2229	1956.27	113.9
2101H	FOGLER LIBRARY INTERIOR PAINTING WEST STAIRWAY	EM	02/24/82	4129	3403.07	121.3
2139H	EAST ANNEX - PAINT ROOM 100 & 102	EM	02/24/82	844	878.36	96.0
2142H	USDA PAINT ROOMS 101, 103, 103A	EM	02/24/82	2280	1498.66	152.1
2143H	U.S.D.A - PAINT ROOMS 216 & 219	EM	02/24/82	1668	825.57	202.0
2144H	WINGATE HALL - PAINT 2ND FLOOR MENS ROOM & 2ND FLOOR VESTI	EM	02/24/82	1682	850.11	197.8
2157H	BCC GYM - PAINT MEN'S AND WOMEN'S LOCKER ROOMS ETC.	EM	03/15/82	1183	998.36	118.4
2161H	U.S.D.A - PAINT ROOM #102	EM	03/18/82	1267	761.56	166.3
2162H	U.S.D.A - PAINT ROOM #100	EM	03/18/82	568	195.33	290.7
2114H	GARAGE - INSTALL OVERHEAD DOOR & OPERATORS	JK	03/19/82	2680	2299.10	116.5
2115H	STEAMSHOP - INSTALL OVERHEAD DOORS AND OPERATORS	JK	03/19/82	2184	1528.40	142.8
2165H	U.S.D.A - PAINT ROOM 107	EM	03/19/82	829	636.05	130.3
2166H	U.S.D.A - PAINT ROOM 106 & CEILING REPAIR	EM	03/19/82	2670	1786.80	149.4
2105H	CENTER STEVENS-PAINT SOUTH STAIRWAY	EM	03/26/82	2330	2348.98	99.1
2124H	FERNALD HALL - CHANGE STEAMTRAPS	CS	03/26/82	1634	147.80	105.5
2134H	WINGATE-PAINT SM OFFICE,LOBBY,& STUDENT EMPL. OFFICE	JK	03/26/82	893	759.50	117.5
2001H	HEATING PLANT, REPLACE DOUBLE DOORS	JK	03/[illegible]/82	1168	1096.84	106.4
2096H	KENNEBEC-MAKE REPAIRS TO STUDENT ROOM LOCKS	JK	03/[illegible]0/82	990	724.77	136.5
2137H	STODDER HALL - PAINT & PAPER BOTH FRONT STAIRWELLS	EM	03/30/82	1761	1413.73	124.5
2149H	ROGERS HALL - CHANGE STEAMTRAP CAGE UNITS	CS	03/30/82	917	976.30	93.9
2171H	LITTLE HALL - PAINT ROOMS 301, 301A, 301B	EM	03/31/82	2442	1376.39	177.4
2181H	UNION BUILDING - CLASSROOM A - INSTALL CARPETING	JK	03/31/82	2107	1542.17	136.6
2077H	SOUTH STEVENS-PAINT ROOMS 46,46-A,46-B	EM	04/05/82	879	977.78	89.8
2140H	FERNALD HALL - PAINT ROOMS 212 & 208	EM	04/05/82	1095	1058.13	103.4
2146H	SHIBLES HALL - PAINT ROOM 159	EM	04/05/82	835	785.80	106.2
2170H	HAUCK AUDIT - PAINT CEILING	EM	04/05/82	2142	1828.59	117.1
2159H	SOMERSET HALL - CONSTRUCT & INSTALL NEW BATHROOM COUNTER	EM	04/12/82	910	878.13	103.6
2141H	BENNETT HALL - PAINT ROOM 112 & 113	EM	04/16/82	634	640.52	98.9
2145H	MAPLES - PAINT ROOMS 2, 5, 6, & 15	EM	04/16/82	1844	1204.84	153.0
2180H	USDA - PAINT 1ST FLOOR LADIES LOUNGE & ROOM 202	EM	04/22/82	2764	1418.84	194.8
2190H	USDA - PAINT COMPUTER ROOM AND ROOM 204	EM	04/22/82	2247	883.19	254.4
2517H	YORK VILLAGE - REPAIR TO HANDICAP BATHROOM	DN	04/22/82	1248	902.52	138.2
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TOTAL	73 PROJECTS			136474	102077.87	133.6

SAFETY IMPROVEMENT PROJECTS

JOB #	JOB DESCRIPTION	PROJECT MANAGER	DATE COMPLETED	BUDGET	ACTUAL COST	PERFORMANCE (%)	
2038H	ALUMNI HALL - INSTALL EMERGENCY EYE-WASH/SHOWER STATION	JK	09/16/81	1000	684.15	146.1	*
75424	OAK HALL - INSTALL FIRE ALARM	JM	11/11/81	16000	14958.00	106.9	*
2120H	UNIVERSITY PARK APTS, PURCHASE & INSTALL SMOKE DETECTORS	HM	12/22/81	3000	1892.35	158.5	
2132H	CUMBERLAND HALL - PAINT 14 STUDENT ROOM CEILING	EM	01/12/82	648	584.51	110.7	
2519H	POLICE & SAFETY - EMERGENCY LIGHTS	DN	03/15/82	900	881.19	102.1	
2515H	CUTLER HEALTH CTR. - INSTALL SMOKE DETECTORS IN CORRIDORS	JM	03/22/82	4000	4393.16	91.0	
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TOTAL	6 PROJECTS			25548	23393.75	109.2	

SUMMARY OF COMPLETED JOBS

SUMMARY OF COMPLETED JOBS

TYPE	TOTAL NUMBER OF PROJECTS	TOTAL BUDGETED	TOTAL ACTUAL COST	AVERAGE PERFORMANCE (%)
ALTERATION/RENOVATION	36	208414	205226.00	101.5
ENERGY CONSERVATION	1	1377	1342.49	102.5
HANDICAPPED	1	500	186.51	268.0
MAINTENANCE	73	136474	102077.87	133.6
NEW CONSTRUCTION		0	.00	.0
SAFETY IMPROVEMENT	6	25548	23393.75	109.2
TITLE IX		0	.00	.0
GRAND TOTAL	117	$372313	$332226.56	112.0

CARPENTER SHOP LABOR PERFORMANCE

FOR PROJECTS COMPLETED DURING FISCAL YEAR 1981-82

JOB #	PROJECT DESCRIPTION	ESTIMATED LABOR HOURS	HOURS WORKED AGAINST ESTIMATE	HOURS WORKED NO ESTIMATE	PERFORMANCE (%)
2234A	FOGLER LIB.-ADD. MASONRY WATERPROOFING 2235A	80	26.50		301.8
2263A	HITCHNER - S.S.HOOD: INSTALL OVER AUTOCLAVES-RM/249	0		4.00	***
2289A	U.S.D.A BLDG.-BUILD ROOM WITHIN ROOM 204	96	61.00		157.3
2001H	HEATING PLANT, REPLACE DOUBLE DOORS	35	42.50		82.3
2059H	CROSSLAND ALUMNI CTR.-CHANGE DARK ROOM INTO OFFICE.	45	68.00		66.1
2060H	BOARDMAN-DIVIDE ROOM W/ PARTITION,DOOR,ECT. FOR COMP. ROOM	63	54.00		116.6
2061H	GRANDSTAND-PAINT LADIES BATHROOM,CHECK SIGNS,CHECK WINDOWS	0		1.00	***
2065H	PRESIDENT'S HOUSE-PAINT SUN PORCH	0		8.00	***
2067H	UNIV.PARK-INSTALL 1/4 TEMP GLASS ON SIDE LIGHT BY ENT.	23	18.00		127.7
2070H	CUMBERLAND - REHABILITATION TO NORTH ENT. GRANITE STEPS	427	275.50		154.9
2072H	FOGLER-BUILD OFFICE PARTITIONS,INSTALL DOOR,FRAME,REC.	80	64.50		124.0
2075H	MEMORIAL GYM-REPAIR CEILING IN MEN'S LOCKER ROOM	60	78.00		76.9
2083H	BCC BOOKSTORE-SECURE FR DOORS,INSTALL CENT POST	16	29.00		55.1
2084H	H.H.H - EXPANDED VERSION OF LAUNDRY RENOVATIONS	32	32.00		100.0
2086H	ENGLISH MATH BLDG-CONSTRUCT 2 TEMP. OFFICES,4TH FLOOR	87	74.00		117.5
2087H	COBURN RM 21-NEW COUNTER TOP & VINYL SHEETROCK 2 WALLS,SIN	64	19.00		336.8
2089H	YORK COMMONS-CONSTRUCT STORAGE AREA WITH DOOR,KEY IN KNOB.	48	43.00		111.6
2096H	KENNEBEC-MAKE REPAIRS TO STUDENT ROOM LOCKS	100	84.00		119.0
2097H	AROOSTOOK-MAKE REPAIRS TO STUDENT ROOM LOCKS	100	73.00		136.9
2103H	STODDER COMMONS-RELOCATE BAKERY FOOD	16	3.50		457.1
2104H	LITTLE HALL-REPLACE 3RD FL CORRIDOR CEILING	48	41.00		117.0
2107H	HONORS CENTER-PARTITION OFF AREA FOR OFFICES	71	50.50		140.5
2116H	POLICE & SAFETY - REPLACE STAIRTREADS WITH 3/4 PLYWOOD	32	32.00		100.0
2123H	AUBERT - RENOVATE ROOM 355 AS PER DRAWING	32	36.00		88.8
2127H	SERVICE BLDG - ALTERATION TO CONFERANCE ROOM	38	41.50		91.5
2133H	MEMORIAL UNION ALTERATION OF HOLE IN WALL - GALLERY	16	73.00		21.9
2135H	GANNETT,KNOX HALL-REKEY ALL STUDENT ROOM LOCKS	60	76.00		78.9
2137H	STODDER HALL - PAINT & PAPER BOTH FRONT STAIRWELLS	0		2.00	***
2140H	FERNALD HALL - PAINT ROOMS 212 & 208	4	4.00		100.0
2146H	SHIBLES HALL - PAINT ROOM 159	0		2.00	***
2159H	SOMERSET HALL - CONSTRUCT & INSTALL NEW BATHROOM COUNTER	16	25.00		63.9
2166H	U.S.D.A - PAINT ROOM 106 & CEILING REPAIR	32	28.00		114.2
2170H	HAUCK AUDIT - PAINT CEILING	26	26.00		100.0
2171H	LITTLE HALL - PAINT ROOMS 301, 301A, 301B	0		1.00	***
2181H	NORTH STEVENS-POLITICAL SCIENCE DEPT-NEW ASPHALT TILE FLOO	80	82.00		97.5
2183H	LORD HALL - REMOVE OLD CARPET & INSTALL NEW IN BAND ROOM	91	79.50		114.4
2512H	126 COLLEGE AVE - COMPLETION OF ORIGINAL PROJECT	114	120.00		94.9
2514H	HAUCK-RENOVATION INTO 3 OFFICES	210	259.00		81.0
2515H	CUTLER HEALTH CTR. - INSTALL SMOKE DETECTORS IN CORRIDORS	10	2.00		500.0
2516H	AUBERT HALL - ROOM 365 RENOVATIONS	108	168.50		64.0
2517H	YORK VILLAGE - REPAIR TO HANDICAP BATHROOM	64	65.00		98.5
75441	STEVENS RM 215 - 2 OFF.,LOWER CEILING, INSTALL TILES, ETC	64	37.00		172.9
75438	SCIENTIFIC RESEARCH - LAND & WATER CENTER, STAIRWELL	150	176.00		85.2
75729	ALUMNI HALL- RENOVATION TO BUSINESS OFFICE	638	457.00		128.3
		3276	2964.50	18.00	110.5

Your PR--Good, Bad, or Indifferent

By Robert S. Hunt
Loyola Marymount University

A colleague of ours, of some forty years experience as a plant administrator, recently observed, "In my opinion the biggest problem with the physical plants throughout the country today is lack of credibility".

Let me cite some examples that seem to reinforce that observation.

One major Rocky Mountain University inherited a new President. Mind you, up to that point, the outgoing President, and the plant director, believed the plant operation was doing O.K. Lo, and behold, the first order of business for the new President was to call for a management audit of the entire plant operation.

Another large, public institution changed Chancellors this past year. Whereas the old Chancellor, a personable, friendly, sort, supported plant efforts, the new "guy on the block"--a different personality--did not but rather started off by complaining about poor plant service, costly services, bad plant relations, inattention to the grounds maintenance of his residence and ad nauseum.

I recently joined a new campus. Upon my first meeting with the University's Executive Vice-President, his lead question was, "Have you fired any of those lazy employees of yours yet?"

I was privy to a current outside, and respected, consultants report made of a plant operation. The whole gist of this report was the apparent bad "image" of the plant in the eyes of the university's faculty, staff and students.

How often, particularly you newer plant administrators, have you approached your boss with a problem and recommended a solution only to have him reply, "Let's get someone (presumably an expert) from the outside and find out what he thinks?"

Not too many years ago I was visiting a major science building on my campus and was subjected to highly critical language from a leading faculty member. He wanted to know why was our campus so far behind in maintenance. I attempted to explain the usual reason--lack of funding. Somehow he had difficulty understanding. When I returned to my office I dug out a copy of Harvey Kaiser's publication on deferred maintenance.

I sent it to the enraged faculty member. One month later I got a note from him, thanking me and stating he read Kaiser's report and gained a real appreciation of our maintenance problem. Additionally, he said he would volunteer to help with convincing higher officials of the need for more funding. It then dawned on me that Harvey had written words, in a scholarly style, best understood by the academician. For your information, Harvey Kaiser, a Ph.D., is Vice-President for Facilities Administration (also an associate professor) at Syracuse University.

What I'm suggesting to you, by just citing a few examples is that we had all better wake up and become cognizant of some new problems, new challenges we are facing at this point in time. It is no secret that higher education has its share of financial troubles. It should likewise be no secret to us that we sit, usually, as the purse holder of the largest budget on a campus. If this be so, and since we are not "academic", it should come as no surprise that we are the logical group to be besieged.

In one sense, if we are going to be subject to a management audit, if an outside consultant has been retained to look us over, if our complaints are mounting about our services, if we are being accused of "charging" too much for our jobs, if our boss believes "others" know more than we about plant maintenance--we, indeed, are guilty of losing our credibility!

Our task, then, is to set in motion a well-conceived plan of action to counteract this situation. Certainly a major element of that plan must be an improvement in our public relations.

Concentrated Preventive Maintenance Program

By Fred Garcia, Director of Physical Plant
University of Illinois - Chicago

The University of Illinois at Chicago is the city's largest state university, and is currently divided into two campuses. The Medical Center campus was established in 1879 and is comprised of 32 buildings totaling 3,736,230 square feet with 45 acres of grounds.

The Chicago Circle campus, with which this paper is concerned, was established in 1963 and is comprised of 26 buildings totaling 3,276,663 square feet on 118 acres of prime city-located land. This campus is primarily an urban "commuter" university serving approximately 21,000 students. The university curriculum offers approximately 90 various undergraduate degrees, 39 Masters' degrees and 22 Doctorate degrees.

The physical environment of Circle Campus was purposely designed to emphasize the urban setting in which it functions. The 26 distinctively contemporary buildings house an array of classrooms, laboratories, studios, workshops and libraries, all furnished with the latest educational equipment.

The Lecture Center and classrooms were our primary targets for Concentrated Preventive Maintenance. Classrooms at Chicago Circle accommodate approximately 30 students, while the Lecture Center rooms vary in size from a 40-student capacity to a 200-student capacity.

The Physical Plant Department has been actively involved in a planned Preventive Maintenance Program since the birth of Circle Campus in 1963. During the past several years, the University has been faced with massive budget restrictions and a steady decline in appropriations to higher education. As a result, we have experienced large reductions in our work forces. The responsibility of maintaining over 7 million square feet of facilities with a diminishing staff forced us to re-evaluate our priorities. We discovered through this process that the necessary Preventive Maintenance of our facilities was not being performed as regularly as was required. The most neglected areas were the 15 year-old classroom facilities. Early in 1981, Physical Plant resolved to refurbish these classrooms, and a plan for a Concentrated Preventive Maintenance Program was initiated.

One of the main problems in maintaining our classrooms was their inaccessibility to the Building Maintenance craftsmen. With the campus existing on a quarterly system, our only periods for Preventive Maintenance were during the quarter breaks. Due to a reduced work force and short break periods, Preventive Maintenance on these classrooms became backlogged.

In order to remedy the various building deficiencies in the classrooms, we presented a list of Program Objectives for Concentrated Preventive Maintenance to Campus Administration and the Office of Space Utilization.

Program Objectives

1. To Increase Productivity of Tradesmen: We anticipated that the increased accessibility to the facilities would improve productivity. All vital materials would be available at the job sites, thus discouraging needless traveling-time for extra tools, supplies, etc. The one-time servicing of all units and systems in the buildings would eliminate repairs by individual emergency work orders.

2. To Minimize Downtime of Equipment: This benefit is usually realized in any Preventive Maintenance Program where inspections, lubrications, repairs, and replacements are performed.

3. To Reduce Emergency Repair Calls and Expenses: By refurbishing the buildings through Concentrated Preventive Maintenance, crisis-situation work orders should diminish.

4. To Reduce Out-Of-Pocket Expenses: Funds would be expended specifically for Concentrated Preventive Maintenance, rather than for numerous and repetitive emergency work orders.

5. To Maximize Classroom Utilization: This objective was to be accomplished by a careful scheduling of classes to maximize the utilization of the buildings, resulting in lower energy costs and allowing additional time for Concentrated Preventive Maintenance.

6. To Accomplish Maximum Refurbishment of Facilities: We wished to stress a visual improvement of the classrooms which would be perceived by the faculty and students upon their return to classes. The items to be emphasized included flooring and seating repairs , locker reconditioning, and repainting of highly visible areas.

7. To Increase Planning Potential For Future Maintenance Work: We hoped to establish an historical basis upon which to identify future costs of building systems repairs. This historical information would enable Physical Plant to effectively plan for improved utilization of limited maintenance dollars.

After explaining the objectives and expected benefits of the program to Space Utilization and requesting a reassignation of summer-quarter classes/programs to other areas, we were provided the needed access to the classrooms. The finalized Scope of Program was defined and consisted of the total refurbishment of 7 buildings containing approximately 74 classrooms and lecture halls, resulting in a total of 79,313 square feet. Work was to commence June 15, 1981, and the refurbishment was to be completed by August 17, 1981, in time for resumed fall-quarter classes.

Program Outline

1. Conduct Preliminary Inspection By Trades Foremen: Before conducting the inspection, the question arose as to whom should perform this task. Several possibilities were considered, including a building inspector, a Building Maintenance foreman, a qualified Building Maintenance craftsman,

a maintenance or industrial engineer, a lubricator, an outside contractor, or a consulting firm. For the initial phase of the program, the Building Maintenance foremen were chosen as inspectors because of their familiarity with the classroom facilities and building systems. In later phases of the program, a trained student employee performed the initial survey work with support from the Building Maintenance foremen.

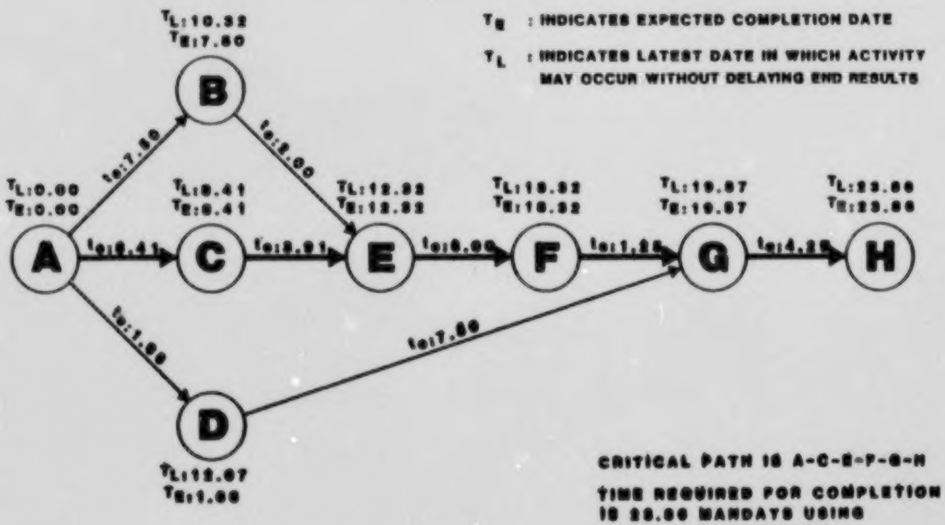
2. Prepare List of Required Corrections: As a result of the foremens' inspections, a list was prepared for each trade of over 70 items which required corrections (see Attachment A-1, columns "A" and "B").

3. Develop Cost Estimates: From the information gathered during the preliminary inspections, time and cost estimates were developed. The procedures for these estimates involved calculating the number of manhours per classroom and/or building, and determining the percentage of involvement required by each trade. Finally, all items were prioritized.

4. Adjust Estimates To Match Available Funds: Low priority items were deleted from the required corrections, in order to accurately match the available funding appropriations.

5. Develop Critical Path For Tradesmen: The final step in the Program Outline was to obtain assistance from the College of Engineering in developing a critical path analysis for each building. Although critical path methods are more likely to be found in manufacturing environments where each task is repetitive, we applied the analysis to our program based upon the time estimates prepared by the foremen. The critical path provided the sequencing required for the program to run smoothly. (Figure 1)

LINCOLN HALL
(CLASSROOM BLDG.)

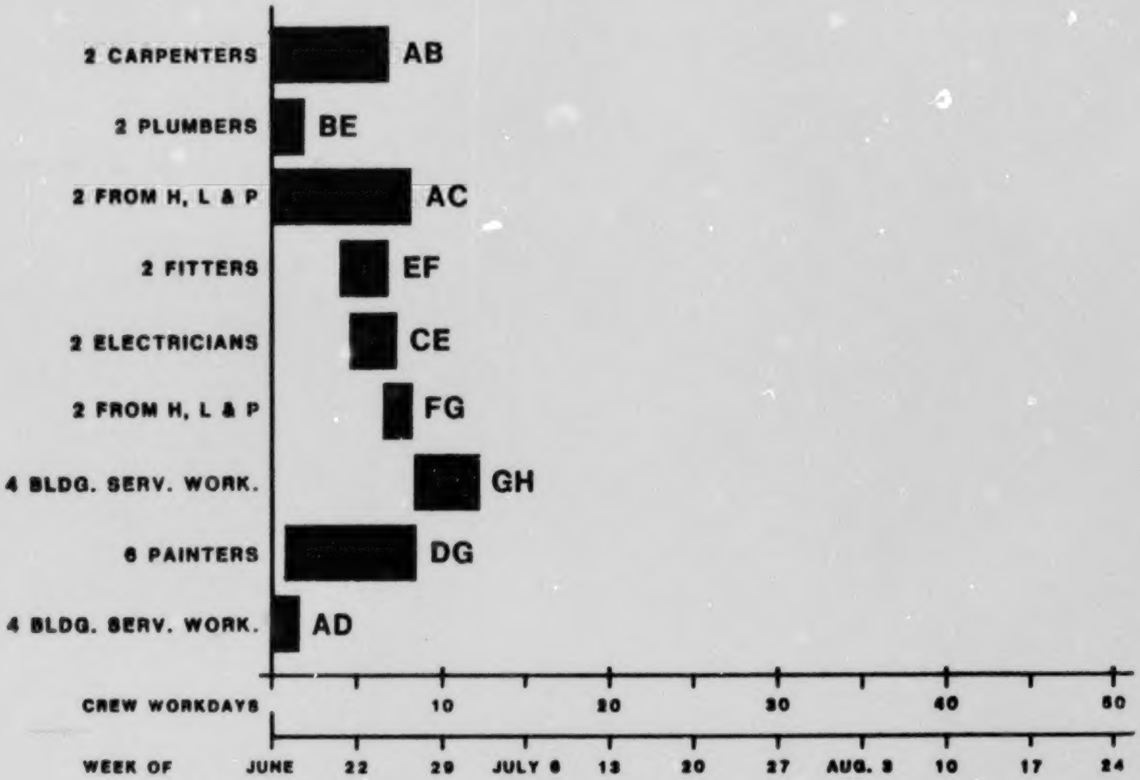

T_E : INDICATES EXPECTED COMPLETION DATE
T_L : INDICATES LATEST DATE IN WHICH ACTIVITY MAY OCCUR WITHOUT DELAYING END RESULTS
T_L:10.32
T_E:7.50
B
T_L:0.00
T_E:0.00
A
te:7.50
te:2.00
T_L:8.41
T_E:8.41
C
te:8.41
te:3.91
T_L:12.32
T_E:12.32
E
te:6.00
T_L:18.32
T_E:18.32
F
te:1.25
T_L:19.57
T_E:19.57
G
te:4.29
T_L:23.86
T_E:23.86
H
te:1.88
te:7.50
D
T_L:12.07
T_E:1.88

CRITICAL PATH IS A-C-E-F-G-H

TIME REQUIRED FOR COMPLETION IS 23.86 MANDAYS USING AVAILABLE MANPOWER

FIGURE 1

After the sequencing was laid out, scheduling of the various crafts was prepared and translated to a bar chart of the estimated time span of the program (Figures 2-A and 2-B). The order of performance was listed as carpenters, engineers, janitors, plumbers, electricians, fitters, painters, and janitors once more for general cleaning. Relamping of lighting fixtures was performed prior to the initiation of the program, as part of our normal contractual relamping policy.



AB	BLDG. MAINT: CARPENTERS WILL INSPECT AND REPAIR AS REQUIRED
AC	HL&P: REMOVE AND CLEAN NESBITTS AND GRILLES
AD	BLDG. SERV: JANITORS TO WASH WALLS
BE	BLDG. MAINT: PLUMBERS WILL CHECK PLUMBING IN WASHROOMS
CE	BLDG. MAINT: ELECTRICIANS WILL INSPECT AND PERFORM MAINTENANCE ON NESBITTS,AND OTHER ELECTRICAL UNITS AS NEEDED
EF	BLDG. MAINT: FITTERS TO PERFORM MAINTENACE ON NESBITTS
DG	BLDG. MAINT: PAINTERS WILL PAINT DOORS,TRIMMINGS,ETC.
FG	HL&P: REPLACE COVERS ON NESBITTS AND GRILLES
GH	BLDG. SERV: GENERAL AREA CLEANING AND FLOOR MAINTENANCE

FIGURE 2-A

PHASE 1 OF THE SUMMER PROJECT

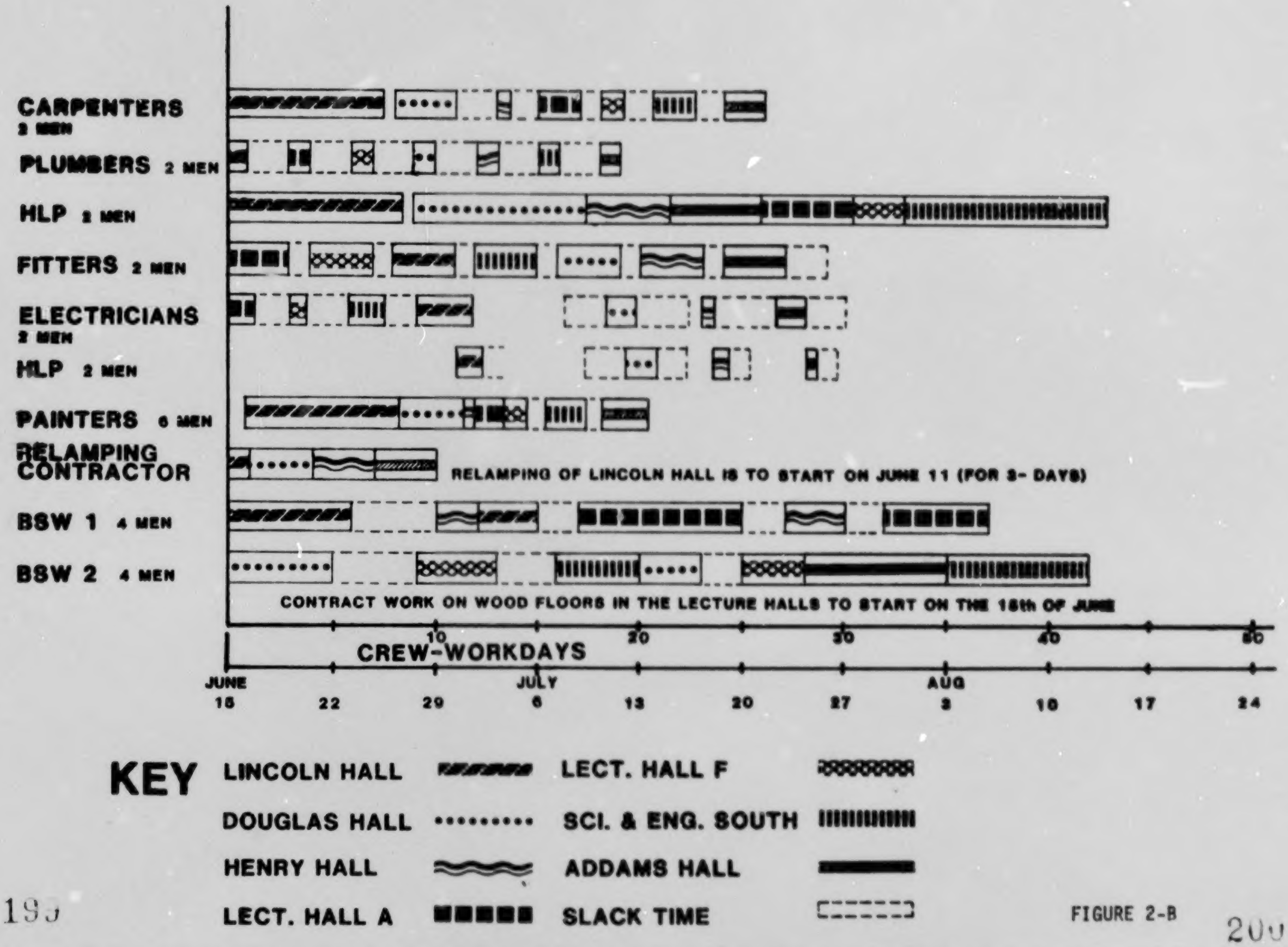


FIGURE 2-B

The various jobs performed included the repair and refurbishment of student desks and chairs, damaged doors, vandalized washrooms and lockers, renewed tile flooring, carpet replacement, re-painted trash containers, re-built bulletin boards, repair of nesbitts and grilles, refurbishment of lecterns, and new construction to replace code violations and/or potentially dangerous situations.

Due to the competitive spirit in which the craftsmen engaged in their jobs, the deadline for the completion of the program was satisfactorily met. The men took great pride in finishing each task before the next group entered the building for the following phases of work.

Upon completion, the trades foremen submitted the actual manhours expended by their work forces for each required correction (see Attachment A-1, columns "C" and "D"). The results of expended time by craft division were as follows:

Percentage By Craft

Building Service Workers	33.5%
Painters	27.8%
Carpenters	15.5%
Electricians	7.2%
Heat, Light & Power	7.0%
Plumbers	5.7%
Fitters	3.3%

A Cost Analysis was then prepared, based upon both labor and material costs, as follows:

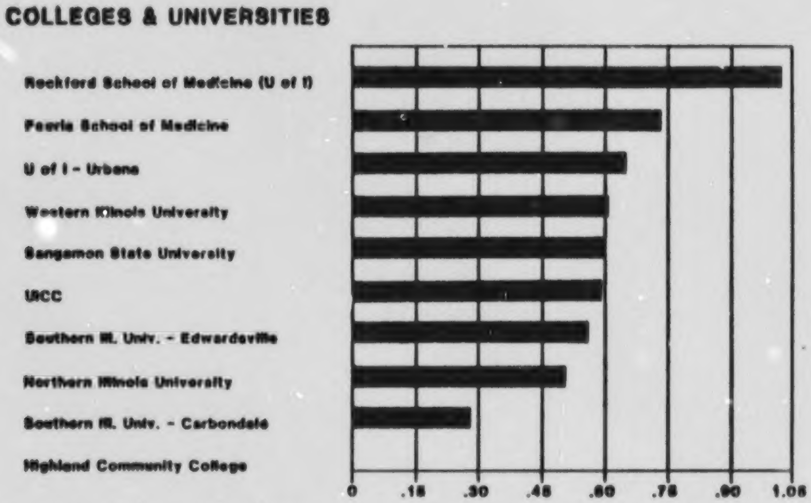
Total Program Cost

Building Service Workers	$32,492.00
Painters	26,950.00
Carpenters	14,750.00
Electricians	7,050.00
Heat, Light & Power	6,831.00
Plumbers	5,570.00
Fitters	3,227.00
TOTAL:	$96,870.00

Cost Comparison

	Program Cost		Cost/Sq. Ft.	
Total Area	All Trades	Bldg. Mntnc.	All Trades	Bldg. Mntnc.
79,313 Sq. Ft.	$96,870	$57,550	$1.22	$ .72

As a comparison with other State of Illinois colleges and universities, Chicago Circle ranks 6th out of 10 in Building Maintenance dollars expended per square foot of facilities (Figure 3). Regarding the "Big Ten" universities, Chicago Circle ranks 5th out of 10 in Building Maintenance dollars per square foot (Figure 4).



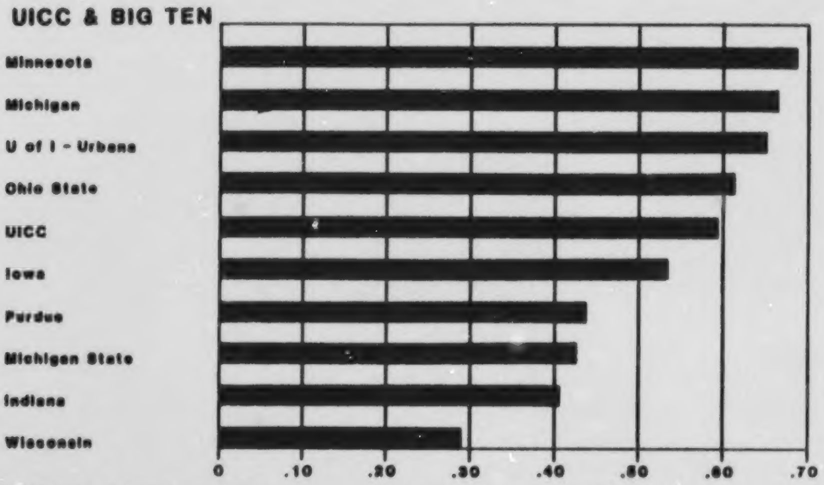
BUILDING MAINTENANCE DOLLARS PER SQ. FT.

FISCAL YEAR 1981

COMPARATIVE COST ANALYSIS

UICC and Illinois Public Owned Colleges and Universities

FIGURE 3



BUILDING MAINTENANCE DOLLARS PER SQ. FT.

FISCAL YEAR 1981

COMPARATIVE COST ANALYSIS

UICC and Big Ten Universities

FIGURE 4

The final process of our Concentrated Preventive Maintenance Program was to publish an internal report of the results, and to prepare an analysis of the benefits realized, as follows:

Benefits of Program

1. Lowered Maintenance Costs: Costs were lowered due to efficient planning and increased productivity. Time and cost standards were established for future planning. The work load of the forces proved to be more balanced, and materials were immediately available. Overtime costs were greatly reduced due to the sequencing of events.

2. Improved Building Systems Efficiency: The building systems were repaired to ensure that they would operate at peak efficiency. This is especially important in light of the recent nation-wide emphasis upon energy management. The equipment life has been noticeably improved and fewer emergency repairs have been required.

3. Improved On-The-Job Safety: Safety conditions improved, as each craft anticipated its potential job hazards before beginning work.

The Concentrated Preventive Maintenance Program at Chicago Circle during the summer of 1981 proved to be an effective, efficient plan which was commended by Campus Administration, as well as by the faculty and students. Campus Administration requested Physical Plant to initiate a "Phase II" plan at the Circle Campus during the period of August 17th through September 21, 1981. As with Phase I, all the buildings involved in Phase II were unoccupied, with the exception of the Behavioral Sciences Building which housed faculty offices. As an experiment, we decided to attempt the program in an occupied area, with satisfactory results. The occupants of the building were most cooperative in working along with the Building Maintenance forces to ensure the success of the plan, and were pleased to witness the improvements on the spot. We then initiated the plan at the College of Nursing at the Medical Center campus, during the fall quarter. Again, the occupants were pleased to see the tradesmen working on their facilities to improve conditions, and have been more cooperative in maintaining their offices, labs and classrooms since the completion.

To this date, the following Concentrated Preventive Maintenance Programs have been completed:

Phase I	Circle Campus	7 buildings	79,313 Sq.Ft.
Phase II	Circle Campus	9 buildings	82,476 Sq.Ft.
Behavioral Sciences	Circle Campus	1 building	26,364 Sq.Ft.
College of Nursing	Medical Center	1 building	160,104 Sq. Ft.

The Physical Plant Department has already initiated the plans for a repeat of the Concentrated Preventive Maintenance Program for Fiscal Year 1983, with the approval of Campus Administration. A larger scope of work has been estimated, and we hope to achieve improved results.

CRAFT: CARPENTERS	Ⓐ TIME EST. BY %	Ⓑ TIME EST. BY HRS.	Ⓒ ACTUAL %	Ⓓ ACTUAL HRS.
1. Replace Missing Base	2	16.64	2.8	27
2. Patch Floor Plates Entrance Doors	1	8.32	0.4	4
3. Patch And Replace Floor Tile	25	208.0	24	230
4. Repair All Seating	20	166.4	17.7	168
5. Repair / Replace Coat Hook Racks	5	41.6	6.5	62
6. Check All Door Hardware	7	58.24	8.4	80
7. Reset Checks	2	16.64	4.0	38
8. Reset Floor Stops	1	8.32	1.6	15
9. Replace / Install New Room Numbers	1	8.32	1.0	10
10. Replace / Install Washroom Signs	0.5	4.16	0.1	1
11. Patch And Sand Chipped Doors	2	16.64	2.8	27
12. Refasten All Loose Wall Astrays	1	8.32	1.5	14
13. Check And Repair Fire Ext. Boards And Cabinets	1	8.32	0.7	7
14. Check And Repair Toilet Stalls And Doors	2	16.64	1.4	13
15. Replace And Sand Wood Handrails Stairways	1	8.32	1.3	12
16. Replace Broken And Crack Glass	0.5	4.16	0.1	1
17. Check All Movie Screen Brackets	1	8.32	0.9	9
18. Service All Lecterns	15	124.8	12.0	115
19. Check And Repair All Tables And Decks In Classroom	2	16.64	1.3	12
20. Lockers: Grease And Repair	6	49.92	3.8	36
21. Drapery Adjustment / Install Drapery Cords	2.5	20.8	4.8	46
22. Install Ceiling Tile	1.5	12.48	2.5	24
TOTAL	100%	832 HRS.	99.6%	951 HRS.

CRAFT: PLUMBERS

GENERAL WASHROOM MAINTENANCE

	Ⓐ TIME EST. BY %	Ⓑ TIME EST. BY HRS.	Ⓒ ACTUAL %	Ⓓ ACTUAL HRS.
1. Service Sinks	10	28	8.6	29.5
2. Faucets	15	42	16.3	56
3. Toilets	15	42	15.8	54
4. Urinals	10	28	9.1	31
5. Service Drinking Fountains	5	14	7	24
6. Flush Water Lines Where Needed	5	14	6.9	23.5
7. Soap Dispensers	4	11.2	2.3	8
8. Rod Drains	3	8.4	2.2	7.5
9. Repack Valves	20	56	24	82
10. Flush And Test Fire Line	4	11.2	2.2	7.6
11. Repair Paper Holder	1	2.8	0.6	2
12. Flush Hot Water Tank	3	8.4	1.7	6
13. Repair Waste Line	1	2.8	0.6	2
14. Remove Sanitary Napkin Dispenser / Install Aluminum Plates	2	5.6	1.5	5
15. Repair Brackets	1	2.8	0.6	2
16. Rod Service Sink	1	2.8	0.6	2
TOTAL	100%	280 HRS.	100%	342.1 HRS.

CRAFT: ELECTRICIANS

	Ⓐ TIME EST. BY %	Ⓑ TIME EST. BY HRS.	Ⓒ ACTUAL %	Ⓓ ACTUAL HRS.
1. Service Building Circuitry	20	99.2	22.5	93
2. Service Nesbitt	15	74.4	18.1	75
3. Check And Service All Switches	4	19.84	3.1	13
4. Check And Service All Outlets	4	19.84	3.1	13
5. Refasten Any Loose Florescent Lighting Fixture	6	29.76	7.5	31
6. Check And Repair Clock	1	4.96	0.2	1
7. Service Contactors	1	4.96	0.6	2.5
8. Service Lighting Remote Controls	1	4.96	0.5	2
9. Service Lighting Dimmer Components	1	4.96	0.5	2
10. Provide Aisle Light Fixture Repairs	1	4.96	0.9	4
11. Assist On Drapery Limits	7	34.72	4.1	17
12. Provide Projection Screen Adjustments	3	14.88	3.9	16
13. Assist Plumber - Sprinkler Lines - Fire Alarm	3	14.88	3.4	14
14. Service Roof Fans	5	24.80	3.6	15
15. Contractor Assist / Power	1	4.96	1.5	6
16. Replace Missing Cover Plates	4	19.84	5.6	23
17. Remove Stage Light Receptacles	1	4.96	1.9	8
18. Remove Back Drop Supports	1	4.96	1.9	8
19. Repair Track Lighting	20	99.2	16.0	66
20. Clean Electrical Closets	1	4.96	0.9	4
TOTAL	100%	496 HRS.	99.8%	413.5 HRS.

CRAFT: FITTERS	Ⓐ TIME EST. BY %	Ⓑ TIME EST. BY HRS.	Ⓒ ACTUAL %	Ⓓ ACTUAL HRS.
1. Bleed Medium Temperature Lines, Nesbitt	45	144	24.2	48
2. Recalibrate Stats	25	80	31.8	63
3. Replace Expansion Joints On Heating And Cooling Main As Needed	5	16	8.0	16
4. Clean Kates Flow Control Valve As Needed	10	32	16.1	32
5. Repair Nesbitt Controls	10	32	16.1	32
6. Replace Switching Relays	5	16	3.5	7
TOTAL	100%	320 HRS.	99.7%	198 HRS.

CRAFT: PAINTERS

	Ⓐ TIME EST. BY %	Ⓑ TIME EST. BY HRS.	Ⓒ ACTUAL %	Ⓓ ACTUAL HRS.
1. Paint Class Room Doors	10	153.6	11	210
2. Paint Class Room Frames	10	153.6	12.8	247
3. Paint Nesbitt / Nesbitt Covers	10	153.6	11.2	216
4. Miscellaneous Washing	15	230.4	16.2	311
5. Paint Stairway Metal Work	5	76.8	4.7	92
6. Paint Locker Fronts	10	153.6	7	134
7. Refurbish Loose Metal Chairs	5	76.8	1.7	31
8. Touch Up Fixed Seating As Necessary	10	153.6	14.5	280
9. Paint Staircase	5	76.8	5.6	108
10. Lecture Center Misc. Painting (Handrails, Window Metal, Convectors)	10	153.6	6.2	119
11. Lecture Center Varnish Doors And Trim	10	153.6	9.1	177
TOTAL	100%	1536 HRS.	100%	1925 HRS.

Vehicle Fleet Management--Forgotten and Unloved?

By John D. Stevenson
University of California, San Diego

Through my association with PCAPPA and APPA, I have seldom heard much said regarding management of what is probably one of the most expensive and sensitive areas of your equipment inventory. Regardless of how large your vehicle fleet is, you have quite an investment, one which should be cared for. Campus officials will expound on the value of a building and its maintenance costs while few of them can tell you how many vehicles are in the fleet. In some cases, the value of the fleet exceeds that of a building. The problem may be due to the fact that 50, 100, or 200 of these $7,000-$8,000 assets are scattered and not looked at collectively.

What I would like to accomplish in the time that I have is to assist you in establishing and maintaining a professional fleet, garage, transportation division, or whatever title you choose to call a motor pool.

Selecting a Fleet Manager, Equipment, and Facilities

First thing Monday morning you receive a phone call. "Hello Mr. or Ms. Director, this is a concerned Physics professor and I was wondering why one of your vehicles was parked outside the Pussycat Lounge this past weekend?" After a brief, fervent prayer that none of your staff is involved, you tell the professor the matter will be investigated. Findings indicate the vehicle was checked out by your Vice Chancellor! Now what? I'm not going to make it easy and tell you how to handle a situation of this nature, but I am going to tell you how important a good fleet manager is at a time like this.

A recent survey by the National Association of Fleet Administrators on ranking of skills desired resulted as follows: (1) interpersonal communication, (2) report writing and correspondence, (3) supervision, (4) budgeting, (5) negotiating, (6) statistical analysis, (7) insurance, and (8) auto mechanics. Note that mechanical skill ranks dead last! It used to be a manager was promoted from within; the only criteria was to have grease under his or her fingernails and scarred knuckles. With today's federal, state, and local mandates on emissions, vanpooling, information systems, and labor relations, a fleet manager should be selected with as much consideration as you would give to hiring any other division or department head. Simply illustrated, if you were not in, and your fleet manager received the same phone call, the situation would still be handled correctly.

Based on the number of vehicles to be maintained, the size of the maintenance facility and type or amount of equipment should be up-to-date and organized. Service bays should be designed to aid in expeditious repairing and servicing of vehicles; i.e. overhead air and lube reels, roll-away tool drawer units, hoists. If you furnish hand tools, furnish good quality with a replacement warranty. The idea is to keep the mechanic from spending half the time getting items needed. Whenever possible, have parts delivered and, if sending vehicles out for repair, have the vendor pick up and deliver or use student drivers. Using mechanics to run parts or deliver cars can be expensive, not to mention extended downtime on your fleet.

No amount of magic additives can take the place of a good preventative maintenance program. Because all of you are concerned with Physical Plant operations, I don't need to expound on the benefits of PM systems. I only encourage you to give the same effort to the vehicle fleet as you would power plants, elevators, buildings, or grounds.

Establishing Fleet Size, Usage, Controls, and Type of Vehicles

Controlling fleet size begins with establishing usage criteria. Generally, mileage minimums are used, or in cases of low mileage accumulation but high priority (i.e. emergency and service vehicles), days are used. All daily pool and assigned vehicles must then be evaluated and those not meeting miles/days use should be disposed of or reassigned. In the good old days of low cost/mile, getting a department to turn in a vehicle was a difficult task. Now public and private institutions are keenly aware of the expense of operating an automobile. Just ask a business officer how much was spent last time he or she filled their gas tank!

Write a policy which clearly states official use rules and regulations. Include department, driver, and fleet manager responsibilities. Instruct users on what to do in case of an accident and limits of liability.

Set up a professional, business-like dispatch and reservation desk. Issue the customer a cleaner, better running vehicle than his or her own. The customer's first impression of your office, dispatcher, and vehicle should be positive. Just because we are not Hertz or Avis doesn't mean we should operate a second rate service.

Determine type of vehicles needed. Under or over specs will be costly and shorten the life of any vehicle. Keeping usage figures will help determine what type of vehicles are needed for the daily pool. Selecting a vehicle involves many factors: (1) fuel consumption, (2) maintenance and repair history, (3) resale value, (4) reliability, and (5) availability of warranty work and parts.

Keep fleet updated. A vehicle should be replaced when it becomes uneconomical to repair or maintain. Disposal methods include local sale, auction, or wholesalers. I have found auctions to be best for institutional fleets. While the selling price may not be as much, by the time you add handling costs, advertising, starting dead batteries, and inflating tires of those which linger on the lot, you'll be ahead by auctioning off all units in one instance.

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Establishing Recharge Rates

Most garage/fleet operations are self-supporting. There are different accounting techniques and each of you has to suffer some sort of financial mandates either by federal and state policies, grants, endowments, or whatever fund source. But the basic premise is to recover all costs. For audit purposes and sensible financial management, I recommend using fixed/variable cost method. Vehicle rates should be set as a dollar per day/month plus cents per mile. Example:

Fixed Costs	Variable Costs
Salaries	Maintenance and repair
Benefits	Fuel and oil
Insurance	Tires
Equipment Reserve	Parts and supplies
(vehicle depreciation)	Support services: Graphics
	Storehouse
	Phones
	Mail
	Miscellaneous

Determine fixed and variable costs for each category of vehicle. Amounts will vary according to depreciation schedule and insurance. Vehicle usage data can be used to determine monthly and daily rental rates. Time doesn't allow me to launch into a detailed rate setting description at this meeting. Those here who have bumped heads with the people wearing green eyeshades can appreciate the time necessary to do proper justice to this subject.

As you can see from the following tables, there are two methods of straight line depreciation: one for rates restricted to recovery of original cost only and one for those institutions who are allowed recovery based on future replacement cost. Rate setting by vehicle category has the benefit of a less complex recharge structure. Having a different rental rate for each class of vehicle plus each year model is too time consuming and unnecessary.

STRAIGHT LINE DEPRECIATION - RECOVERY OF ORIGINAL COST ONLY

Vehicle #	Description	Original Cost	Expected Life (mos.)	Residual Value	Monthly Reserve Accrual
0000	'82 AMC Concord Sedan	$7,000	60	$1,500	$92

STRAIGHT LINE DEPRECIATION - RECOVER REPLACEMENT COST

Vehicle #	Description	Replacement Cost	Expected Life (mos.)	Residual Value	Monthly Reserve Accrual
0000	'82 AMC Concord Sedan	$10,000	60	$1,500	$142

RATE SETTING BY VEHICLE CATEGORY

Vehicle Category	Fleet #	Monthly Reserve Accrual	Average	Monthly Insurance	Remaining Fixed Expense	Total Monthly Rate
Medium Sedans:						
'82 AMC	10	$920				
'80 Volare	5	$880				
'75 Malibu	8	$500				
TOTALS:	23	$2,300	$100	$20	$120	$240

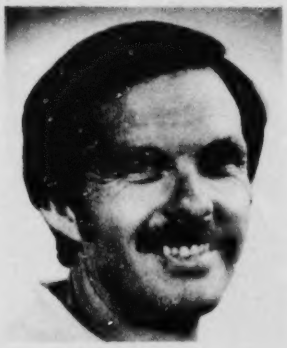
RATE SETTING BY VEHICLE CATEGORY (Con't.)

	Avg. Days Used/Month	Daily Rate	% of Current Variable Cost	Projected Variable Cost	Projected Mileage	Mileage Charge
TOTALS:	20	$12	3	$10,000	100,000	$ .10

Size and complexity of fleet dictates how extensive your requirements need to be for management information. You also have to take into consideration what type of data you are frequently asked to provide.

Computer systems are not always the answer. You find yourself drawn into an elaborate, costly system providing data you don't need. The best approach is to customize a program for your particular needs; be it computer or manual. Above all, the system should be your tool.

In conclusion, let me stress the importance of establishing and maintaining a good relationship with the campus community. Put on a professional service and they won't forget it; they might even love it!



What the Hell Are We Building Now?

By Brian J. Whalen and "Buzz" Nelson
University of Nevada·Reno

All too often, either at final design or during construction of a job, we have all heard the words, "What The Hell Are We Building Now?"

Maintenance of facilities is one of the Physical Plant's major missions. The five basic types of maintenance for which we are responsible are:

Custodial Maintenance
High visibility, low discomfort

Heating, Ventilation and Air Conditioning
Low visibility, high discomfort

Electrical
No visibility, total discomfort when inoperative

Repairs and Improvements
Medium visibility, medium to high discomfort

Grounds
High visibility and low discomfort

It is obvious then, that either high visibility or high discomfort maintenance areas are very critical since the Physical Plant is so easily and frequently accessible by telephone. The Physical Plant should not have to "make up the difference" when a new building is completed, so it becomes imperative that the Physical Plant have a voice in the design and construction of all new facilities. Why not take steps now to eliminate the majority of the visibility or discomfort telephone calls and the resultant maintenance labor.

Proper planning and review by the Physical Plant can balance construction design to minimize visibility and discomfort problems, improve safety, minimize long-and short-term operating expenses, and even play a little politics.

This day and age of tight money and shrinking budgets demand that our construction dollars be spent wisely and that the question, "What The Hell Are We Building Now?," not go unanswered. The Physical Plant can be of great assistance in this area if certain criteria are established for new construction projects.

The Physical Plant requires the following:

1. Representation on all planning and design committees.
2. Preliminary, intermediate and final plans and specifications.
3. Itemized cost breakdowns (prior to approval of final plans).
4. Involvement in the setting of priorities for project alternates.
5. All construction committees be AD HOC and that these committees be disbanded at Bid Time.
6. All requests and contacts with Contractors and Architects be through and by the Physical Plant.

In many instances, our faculty have worked for years in crowded areas in outdated buildings. It is only natural that they act as if Santa has just sent the Christmas catalog when told they will get a new facility. Their needs sometimes are mind boggling; space doubles or triples, and equipment they have never seen or needed, is now mandatory. When the final construction plans arrive, it is difficult to determine where all the luxury requests originated.

Keeping this in mind, we would like to review some areas that recently involved the UNR Physical Plant. Some we caught and had corrected, others we missed.

It is important to work closely with the architects; however, sometimes they need to be reminded we are the employer and they are the employee.

In reviewing the cost breakdown on our Special Events Center, it was apparent that the building would be over the budget of $22,700,000. As a result, the Physical Plant conducted an evaluation of the cost breakdown, (see Figure 1), plans and specs to see if there were any items that the University could live without. Here are some examples of what we found:

1. Forty-foot high precast double tee wall sections in 7'-6" and 6'-0" widths, having a bevel of 1/2" and 3/16", respectively 1'-9" from each end, requiring a special casting bed for each of the sections. This was on a building 95' high and 324' diameter. Will anyone notice this 1/2" or 3/16" taper? Is it worth the extra expense? These double T sections are typically cast with the T down; however, the specs called for them to be cast face down, thus making it almost impossible to provide the taper. Deleted taper requirement.

2. Specifications for "Sound and Audio" require the contractor to retain the services of the designer to test the sound system for seven 16-hour days. Since when does the contractor pay the designer, who has already been paid for the job?

3. The specifications for Boulder Removal require the contractor to: "Remove boulders without breaking, damaging, scraping, scarring or marring in any manner." Some of these boulders weigh five tons. There were about thirty 20 cubic yards truck loads involved. Modified the specs to permit contractor to use standard heavy equipment.

4. "2,500KVA Transformer - $45,000." There is only a connected load of 3,500KVA for the entire campus (2.5 million square feet). Why does this 200,000 square foot building require so much capacity? The transformer was reduced to 1,500KVA.

5. "700 Ton Chiller - $422,500." Because of the nature of the building events and the temperature swings in Reno -- how about free cooling? The arena chiller was deleted; only offices and conference facilities were air conditioned.

6. "Microphones, etc. - $28,064." This job included 96 microphones: could some of these be purchased directly at a later date to save general contractor overhead and profit? Deleted these from the budget.

7. "Theatrical Conversion - $2,679,000." This item was placed in the alternates and the bid was nearly twice the architect's estimate of $1,495,000. There were insufficient funds to include this alternate.

8. "Flagpoles - five at $2,800 each." Why five flagpoles? Three of the five were deleted.

9. "Aluminum letters for graphics - $50,000." Changed interior graphics to standard plastic laminate.

10. "Sanitary Napkin Dispensers - $2,600." So much time was spent repairing vandalized coin boxes that all these machines have been removed from existing campus buildings. Deleted this item.

11. "Paint the trusses above the arena - $50,000." With lights 60' above the floor, located below the trusses, who will ever see if the trusses are painted or not? Deleted this requirement.

12. "Terrazzo floors on concourses - $221,560." Practical, however, changed to rubber tile for budgetary reasons.

13. "Acoustic ceiling over arena - $419,479." Aesthetic item, deleted. Subsequently bid as an Alternate.

14. "Rollup shutters on concession stands - $24,660." Modified doors.

15. "Exterior stair lights - $120,000." These were hollow aluminum handrails with continuous 8' fluorescent tubes inside and slits cut in the bottom of the aluminum (primarily for aesthetics). How easy is it to maintain these? Deleted lighted rails from the project.

Winston Churchill once said, "We often stumble over the truth and then get up and hurry off." The Physical Plant chose not to hurry off on this project.

After a careful review of the justification for items similar to those listed above, and the cost for a substitute, we narrowed the list down and cross checked it with the architects and University using departments. A substantial number of expensive items were discovered that could be bid under separate contract, thus saving the general contractors' overhead and profit.

The attached list covers potential cost savings items which were submitted to the President for consideration. The total cost savings for these items was $913,914 and the total deferred contract items was $3,000,761.

1. Architect's Deletions

Casazza-Peetz - April 10, 1981	$ 312,150
Minus added item to accomplish deletions...	-105,100
	$ 207,050

2. Physical Plant Recommendations - Items to be Deleted

Spotlight Platforms	$ 12,960	
Terrazzo Floors	210,787	
Tartan Floor	10,545	
Paint Arena Ceiling	121,500	
Stair Nosing	38,515	
Kitchen Quarry Tile	6,300	
Kitchen Ceramic Tile	10,500	
Mechanical (Chiller)	125,000	
Arena Suspended Ceiling	204,120	
1,500KVA Transformer	10,000	
	$750,227	
Less Items to accomplish deletions	-43,363	
SUB-TOTAL	$706,864	$706,864
Total Deletions		$913,914

3. Physical Plant Recommendations for Items to be placed in separate contracts or furnishings and equipment:

Lockers, Basketball	$ 28,090
Lockers, Miscellaneous	3,180
Projection Screens	11,066
Weights and Training Bench	3,825
Moveable Platform East	100,000
Seating East	15,900
Moveable Platform West	100,000
Seating West	15,900
Theatre Gridiron	135,000
Lighting	65,000
Sound	123,000
Theatrical	1,457,800
Soccer Field	58,000
Seating - 11,050 at $80	884,000
	$3,000,761

There were some items the Physical Plant did not catch on this project. For instance, one of the site soil test borings showed standing water at the 50-foot level. This should not be a problem since Nevada is an arid state with 116,000 square miles of land and not much water. This item subsequently converted to a $79,000 Change Order required to dewater the concrete footings and air tunnels in the building.

Occasionally, the Physical Plant is asked by the administration, "What The Hell Are You Building Now?" when they receive word from a local Senator that $130,000 Federal Grant request has been approved, etc. The Physical Plant does not need to play a passive role in any of the University design/construction areas including the grant application process. The UNR Physical Plant has been successful in obtaining three Federal Grants, with a fourth pending;

1. Nye Hall Dormitory Solar Domestic Hot Water System for $130,000 (HUD).

2. Thompson Student Services Handicap Improvements - Elevator, etc., $99,000 (EDA).

3. Energy Conservation Projects at the Central Heating Plant - $96,200 (DOE).

4. Energy Conservation - Co-Generation Power Plant. Pending loan at three percent interest - $3,400,000 (DOH).

These grant funds, in some cases, have required supplementary funding from the University which the administration has been willing to provide when the Physical Plant has demonstrated the project economic payback.

Comparing the activities of the UNR Physical Plant today with those of ten years ago, it is apparent that with a capable staff and some initiative, the Physical Plant can become active in the decision making process for new campus construction. It is strongly recommended that all Physical Plant directors:

1. Be thorough in reviewing project specifications, plans and cost estimates.
2. Closely evaulate substitutions of equipment. (Exercise caution with the words "or equal.")
3. Become involved in the project early design stages.
4. Establish basic standards for Mechanical, Electrical and Architectural design parameters. e.g.,
    a. Lighting types - High Pressure Sodium for exterior.
    b. HVAC air filtration systems - minimum requirements.
    c. HVAC - outside air or economizer capabilities.
    d. Electrical and Mechanical energy consumption metering requirements.
    e. Architectural - roofing standards.
    f. Architectural - basic interior ceiling types, no Z-spline, use 2' x 2' regressed layin, etc.
    g. Architectural floor finish standards, etc.

The benefits of Physical Plant involvement are:

1. Reduced maintenance costs on new buildings.
2. Reduced operating costs on new buildings.
3. Reduced construction costs by elimination of luxury items.
4. Improved building utilization.
5. Better control of the Physical Plant destiny.

So, let's take the initiative and assure our administration that the Physical Plant can and will make the difference in future construction projects.

SPECIAL EVENTS CENTER
ARCHITECTURAL COST BREAKDOWN
FIGURE 1

Item of Work	Quantity	Unit	Unit Cost	Estimated Cost
DIV. 10 - SPECIALTIES				
Chalkboards	150	SF	7.80	1,170
Tack Boards	170	SF	4.20	714
Directories	3	EA	520.00	1,560
Flag Poles	5	EA	2,800.00	14,000
Aluminum Letters (Graphics)		LS		50,000
Lockers, Varsity, Plastic Laminated	36	EA	360.00	12,960
Lockers, Visitors, Steel	36	EA	82.00	2,952
Lockers, Miscellaneous	26	EA	82.00	2,132
Storage Shelving		LS		8,000
Toilet Partitions	76	EA	290.00	22,040
Urinal Screens	22	EA	120.00	2,640
Toilet Accessories:				
Towel-waste Receptacles	33	EA	240.00	7,920
Sanitary Napkin Receptacles	37	EA	60.00	2,220
Sanitary Napkin Dispensers	10	EA	260.00	2,600
Soap Dispenser	53	EA	45.00	2,385
Seat Dispenser	68	EA	80.00	5,440
Mirror and Shelf	28	EA	130.00	3,640
Shower Accessories		LS		2,000
Fire Extinguishers	30	EA	280.00	8,400
Bronze Plaque	1	EA	1,200.00	1,200
Corner Stone	1	EA	1,400.00	1,400

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Change -- and the Person in the Middle

By Edwin B. Feldman, P.E.
Service Engineering Associates, Inc.

A client once told me that he wanted to make a number of improvements, but wasn't ready to make any serious changes!

That's like a Vice-President asking the Physical Plant Administrator to keep everything in top shape, without spending any money to do it.

But is isn't money that operates and maintains your physical plant: it's what money will buy, and that's primarily people.

Yet, simply adding people doesn't get the job done. Nothing is tougher than trying to use too many people to get a job done.

You, as a manager, delegate your operational activities to supervisors, and they in turn delegate to the workers (although the supervisors, and you, still retain responsibility).

It is that person in the middle, that supervisor, who is the key to your future. Just as a supervisor is judged by his poorest worker, so are you judged by your least effective, and poorest appearing, supervisor. That thought is enough to make anyone uneasy!

The future will be shaped by that person in the middle, that supervisor. Your job is to shape him!

Any change you contemplate will be caused to succeed -- or to fail-- by your supervisory staff.

How can you help to optimize change through your supervisors? In these ways:

1. Involve your supervisors in a continual supervisory development program. Attendance should be required, not optional -- irrespective of the number of years the supervisor has been on the staff. Periodically, that supervisor should be privileged to attend out-of-town events. Part of such a program should involve a reading schedule -- and reporting on that reading.
2. In order for the supervisor to be identified as a member of the management team, rather than as "one of the gang", he should be given a suitable desk and office.
3. Similarly, the supervisor should have secretarial/clerical help. not only for the saving of leadership time, but for psychological reasons as well.

4. A leader should look like a leader. Require supervisors to dress as members of the management team.

5. Make every attempt to physically separate supervisors from their previous coworker friends, if they have risen through the ranks. This might require a change of work shift, a change of buildings, or even a change of departments.

6. Do not permit, if it can possibly be avoided, the demotion of an unsatisfactory supervisor back to the position of a worker. Supervisors may not take their responsibilities seriously if they know they can go back to what they were doing before.

7. Further, do not permit promotion unless the candidate has been in an "acting" position for the new job on at least three occasions.

8. Require the supervisor to be a teacher, expected to conduct training classes.

9. If at all possible, keep the supervisors out of the workers' union. Better, keep them out of any union!

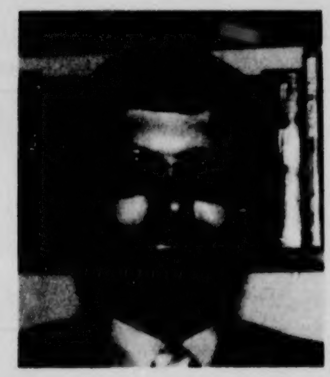
10. Obtain greater productivity from supervisors by providing them with vehicles if their workers are not closely concentrated on the campus.

11. Weed out ineffective supervisors. In addition to measuring them on the basis of apparent performance of their work force, also measure them by comparative absenteeism and turnover rates among their personnel, as related to other supervisors.

12. Do not permit supervisors to "coast" for the last few years of their employment before retirement. This is simply not fair -- it is getting something for the supervisor for practically nothing for the organization.

13. Involve the supervisor in regular discussion, counseling, and especially role play situations. The use of role play provides the self-confidence, the knowledge, and the "practice" necessary for effective performance.

There are changes in your physical plant caused by government, by administration, by accident, by people on campus, and by you. Maximize the result in any case by developing your first-line leaders. It is they who are the backbone of your organization, and it is they who will make or break you!



Managing in Turbulent Times

By Richard N. Lane, Jr.
Pepperdine University

Thank you for that glowing introduction. As Terry was saying all those nice things I couldn't help but feel like a little baby who had just wet his diaper - it gave me an immediate warm feeling but after a while started to get a little uncomfortable.

One of the most exciting things about a conference like this is meeting and talking to fellow administrators - sharing horror stories, telling lies and shaking our heads in disbelief at the "things people do." One thing has impressed me greatly this year - many of you feel yourselves to be in the midst of some crisis situation - personally, professionally, economically, budgetarily. I honestly believe that I have heard the word "crisis" or that specific concept mentioned in every technical paper and general session this week. And crisis is a nation-wide concern. Word has recently leaked out, in spite of government efforts to suppress it, that we are in the midst of a nation-wide economic crisis. There is a crisis in the Falklands. There is the energy crisis. The Middle East crisis. The unemployment crisis. Even the Dodgers are under .500! Our world is filled with crisis and we APPA members are certainly not exempt.

But crisis need not be altogether evil. I appreciate the Chinese pictograph of the word "crisis." It is a combination of the words "opportunity" and "threat." The idea here is that whenever a crisis situation exists, there exists not only the rough sailing in perilous seas that can sink the ship of state, but also the prospect of coming out with something much better than you started out with. The crisis that exists today in the area of physical plant administration offers many opportunities. Our challenge is to realize that and take advantage of these opportunities.

We have an information opportunity. More is being spoken, written and thought about our field today than ever before. Excellent literature exists to heighten our awareness and that of the people with whom we work. Seminars conducted by APPA, Service Engineering Associates and others are more professionally done and contain more practical information than at any time in history. Our superiors and their superiors are being forced to give attention to concerns of plant deterioration, energy management, capital renewal and renovation, etc. Articles in virtually every major publication have spoken either directly or indirectly about these and other plant-related concerns. The Chronicle of Higher Education has regularly printed articles about deferred maintenance, energy management and other topics - articles which are thorough and supportive of our efforts.

We have an opportunity of clout. As catastrophic as failure of major buildings and systems is, its occurring has given more credibility to our claims that there is a price to pay when preventative work is not done. The closures of buildings and whole schools in the Los Angeles area has been necessitated due to inadequate maintenance which has finally rendered the buildings totally useless. Now, the Board is coming to the facilities guy and saying, "Where does it hurt?" and "How can we help?"

We have the opportunity of technology. Recent innovations in systems computerization, energy management technology, and the tools, materials and methods which we employ have served to make the jobs we do easier than ever - if we know how to use it for rather than against us. In many cases, fewer people can do more work with greater accuracy. New devices help us do everything from finding buried pipes to controlling energy consumption.

Dr. Peter Drucker, the famous management scientist, has called our task, "managing in turbulent times" - in fact, that's what he chose to title his recent book. This turbulence will cause some of us to sink, yet others will come out on top. Our job is to discover the difference between the sinkers and the floaters. Then we can be sure that both we and our institutions are among the floaters, both personally and professionally. The success of our various colleges and universities is directly related to our effectiveness in this endeavor.

In the few minutes that we have remaining together, we are going to talk about some of the things which I believe have stifled our effectiveness as professionals. If some of these smart a little, I hope you will give them careful thought before rejecting them as the inane ramblings of a demented plant administrator.

We have got to identify our problems and face them honestly. It is less important that we find someone else to blame for what is wrong than that we accurately identify our problems and set about to handle them. It is very much like the lady who called home while on vacation in Europe. When she asked how her favorite cat was doing her husband said, "Oh, she died."

Well, the lady was destroyed. That cat was more like a child to her than a pet. She simply fell to pieces. After several minutes she finally pulled herself together and asked her husband, "Why did you do that? Why did you just blurt it out like that? You have ruined my trip. I've never been so upset! You should have just said my precious cat is on the roof but the Fire Department is getting her down. Then when I called from Rome, you could have said that she fell off the roof but the vet thinks she'll be okay. When I called from Vienna you could tell me they are giving her oxygen and from Stockholm you could say it doesn't look at all good. But no! You have to go and ruin my whole trip. I just can't stand it! Let me speak to Mother."

"Your Mother? Well...she's on the roof and the Fire Department is getting her down."

Don't mealymouth around when a problem exists. You need neither overstate nor understate a problem to accurately convey its urgency and that's what is needed - accurate information. Knowing HOW to ask for what you want is much more important than WHAT you are asking for. A little neighbor boy was crying the other day and I overheard an older boy ask him what was wrong. He wailed, "My Mom and Daddy won't buy me a puppy!" The older boy said, "Wait a minute. You're going about this all wrong. First you ask them for a baby brother - they'll settle for a puppy every time!"

Don't be afraid to set your sights high. We must not allow ourselves to be caught up in the foolishness of the budgeting process that gives us the same incremental increase as everyone else. Even in the most austere times, our operations will require substantial injections of additional funds....just to break even. Whenever we understate our need we cheat ourselves and our institutions, not only for that year but for years to come. I don't know about you but I'd have a real hard time selling, "Oh, we understated our need last year to try and help save money." Be sure to state clearly at every opportunity the whole need together with the implications of funding at any lesser level. Your administration has a duty to listen to you and even if they will not, you have a duty to say it!

The fact of the matter is that chances are you're the most expert individual in your institution when it comes to matters of Physical Plant. And yet, in case you hadn't noticed, we've got a real bad image problem. Unfortunately some of our colleagues perceive us as about as bright as the fellow standing in the field holding a rope - he can't remember whether he found the rope or lost a cow. Those perceptions often date back fifteen, twenty-five or forty years and are based on selective memories of the bad times while forgetting the good jobs that have been done. Somehow we must turn that around and let them know that we are just as expert (our preparation is usually more extensive), just as able (we were, after all, the choices of our superiors) and just as concerned about the mission of the institution as they are. Only when we stop thinking of ourselves as "JUST physical plant administrators" will we receive, or for that matter deserve, the respect of our colleagues.

I'm not talking about mutiny. I'm just talking about respect. I guess I'm a lot like Rodney Dangerfield - I just don't get no respect. Six months ago, my doctor told me I only had five months to live. I didn't pay his bill. He gave me another five months. I went to my doctor the other day. He told me to undress. I'm standing there naked. He tells me to go over to the window, open the shade and stick out my tongue. I say, "Why?" He says, "I'm mad at my neighbor." I tell you I get no respect. When I arrived at the hotel this week I asked the girl at the front desk "Do I register with you?" She said, "Not particularly." We wanted to try out those hand driers for the bathrooms. You know, the ones where you press the button and then rub your hands together while the motor runs until the friction of rubbing dries your hands. Anyway, we put one in the Physical Plant department men's room. The other day I noticed a sign attached right above the button, "Press here for a message from our Director."

Somehow we've got to get more respect. I'm convinced that requires exposure. You are going to have to get on as many major committees as possible. No one hates committees more than I do. It seems I've spent 65% of my adult life in committee meetings.

Still, the meetings are important. They can serve to let others know you are a living, breathing human being and improve your image as being capable of providing meaningful input on issues greater than what color of Navajo White to paint the walls.

Many of the people you are going to have to work with are academic types. It's important that you understand what makes those folks tick. A friend of my wife's is married to a Ph.D. She went into the department store the other day and asked for forty yards of lace. The clerk asked her what in the world she was planning to do with 40 yards of lace. She told her, "I'm going to make a nightgown." "Well," the clerk explained, "then two or three yards should be plenty." "But," our friend said, "you don't understand. My husband is a professor and after all those years of research he enjoys the search more than the find!"

These teachers aren't so perfect either. It's just a lot easier to detect a burnt out light bulb or a dirty office than it is a bad lecture or a poor test. Why, just the other day I heard a professor talking to a student right after finals. "I don't understand it. You come to class the first day, don't show up again, come and take the final and get a 93%" The student said, "I'd have done better but you really confused me on that first day."

These high-level types even have domestic problems, just like us. I tell you all this so you will recognize that they're just human and you have every right to go toe to toe with them and be respected for it. The chancellor of a school out our way, not ours, is a very dynamic, fast moving fellow. He is always demanding a lot of himself and is equally demanding of others. One person of whom he demands the most is his wife. Now here is a great lady. She is the epitome of patience and graciousness. In the face of a score of unannounced dinner guests or a spur of the moment trans-Atlantic trip she remains unruffled and calm. One of her friends once asked her how she could remain so placid and happy when subjected to the problems her husband puts her through. "It's really no problem," she replied. "When I become really angry with him, as I sometimes do, I just go into the bathroom, lock the door, open the medicine cabinet on his side, take out his toothbrush and swish it around in the toilet. Then I put it back and you'd be amazed how much better it makes me feel!"

Believe it or not, one of the most important elements in the improving of our image is that we look the part. I appreciate the comments of others this week citing the importance of uniforms for our personnel. I was also glad to hear someone mention that we ought to have our first-line supervisors distinctively dressed. I fear that a grave problem rests even closer to home. Now I recognize that we are not working in a classroom all day and that on occasion it is necessary for us to dress prepared to get dirty. But when we go into the battle with other administrators or academicians we need to be dressed accordingly. The level of respect that we can command will be directly related to the image we portray.

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Now I'm not proposing that you all go out and buy a tailor-made suit for each day of the week. I'm not even certain that the tailor-made suit is the best deal. I had a friend that had a suit custom made. The first time he wore it he was walking down the street when he ran into a friend of his. After exchanging greetings the fellow complimented my friend on his lovely suit. "Well it should be nice," my friend said. "It is custom made and cost me four hundred bucks!" "Well, in that case," the fellow replied, "the arms on the coat really should be the same length. The left arm is about an inch shorter than the right." My friend thanked him for pointing that out and went directly to the tailor to get it fixed. "This suit cost me four hundred bucks, tailor, and the left arm is shorter than the right. I want it fixed;" The tailor said, "If you will just hold the sleeve like this, no one will notice and it will straighten out in about two weeks."

My friend left the tailor shop and ran into another acquaintance. "That's a lovely suit." "It should be. It's custom made - cost me four hundred bucks!" "Well, in that case, they should do something about that pucker on the collar." My friend went right back to the tailor. "This suit cost me four hundred bucks and the collar puckers. I want it fixed!" The tailor said, "If you will just tug down on the back of the coat like this and hold it no one will notice the pucker and it will go away in two weeks." My friend is a reasonable person so he agreed.

Upon leaving the tailor shop he happened upon another friend. "That's a lovely suit!" "It should be. It's custom made - cost me four hundred bucks." "Well, for four hundred bucks they ought to measure you properly. It's cut too long in the crotch!" Now my friend was really angry. He went back to the tailor and said, "Look, I want this suit fixed. I paid four hundred bucks for it and the sleeve is too short, the collar puckers and now I see its cut too long in the crotch." "You're right," the tailor replied. "I'll fix everything you've mentioned. It's just that I'm very busy right now and can't get to it for about a week. Meanwhile, if you'll just walk like this no one will notice that it is cut too long in the crotch." My friend, being an amiable fellow, agreed and walked out of the shop holding his sleeve, tugging at the back of his coat and walking like this. As he walked down the street two fellows saw him. "What do you suppose is the matter with that poor guy?" one asked. "I don't know," the other replied, "but check out that great looking suit he's got on!"

I think it's real important that you be enthusiastic. Enthusiasm is the bridegroom on his wedding night. He goes over to turn off the lights and then is in bed before the room gets dark. Your subordinates, superiors - everyone around you will capture and redouble your enthusiasm. Remember, no one likes a down-in-the-dumps, lackluster, complaining sourpuss. Get excited about what you're doing and, if you can't, then for goodness sakes get out. We've got too many people right now in this profession that wish they were doing something else!

Let's not be overwhelmed by the challenges that lie before us. Folks before us have had similar problems and surely, no matter how great we are, folks that follow us will, too. It's gone on for centuries. In fact, I'm told a story about Michaelangelo. As he lay there on his back painting the ceiling of the Sistine Chapel the intense agony that wracked his body was being funnelled directly into his paintbrush. As he was working one day toward the end of the project, the Pope came by and hollered, "Hey Mike. Come on down. We've decided to paper it!"

In closing, I want to tell you how proud I am to be a part of this group and how grateful I am for this opportunity to speak to you. As you return home to implement all this information you have gathered this week and as you come face to face with reality as it exists on your campus, I am going to say the same thing to you as I said to my wife the other day as she was going out the door on the way to the beauty shop - GOOD LUCK!

Rebuilding a Physical Plant Organization to Meet the Needs of the Future

by William D. Middleton, P.E.
Assistant Executive Vice
President for Physical Plant
University of Virginia

Introduction

The details may vary from one organization to another, but I am certain that all of us in this exciting business of physical plant administration share about the same broad array of needs that must be met; the same shortage of resources with which to meet them. This has always been the challenge of the physical plant administrator, but it seems clear to me that during the decade of the 1980's we are going to get a lot more of that challenge than ever before.

If we are going to be at all successful in meeting this challenge, we must first succeed in the task of building more effective physical plant organizations than we have ever had before. We must be able to show the need and to make our case for resources more effectively than ever before; we must apply the best available technology, management systems, and management practices to our organizations; and we must enhance the skills and productivity of our physical plant work force.

Organization as a Key Element

At the University of Virginia we are trying to do all of these things. My colleagues here this morning are talking about specific aspects of several of them, but I would like to discuss just one of the elements of a successful physical plant department--that of organization itself.

Good organization is not an end in itself. With it alone we can't accomplish much of anything, but without a sound organizational structure it becomes very difficult--and sometimes downright impossible--to be responsive, efficient, or effective in providing support services.

University of Virginia Experience

Over the past several years, we at the University of Virginia have built a new physical plant organization from the ground up. We've tried hard to apply our collective experience to building that effective organization that I've talked about, and I'd like to share with you this morning a brief discussion of how we went about it, and a few of the lessons we've learned along the way.

Up until a few years ago, physical plant functions at the University of Virginia were handled by an unstructured, fragmented conglomeration of organizations that was widely seen by the University community as ineffective, inefficient, and unresponsive.

The University administration gave us the opportunity to build a completely new organization with no real constraints on what we could or couldn't do organizationally, and no limits on what we could do in the way of modifying, establishing, or disestablishing positions, or reassigning people, so long as we remained within budgets and overall ceilings, and satisfied the State's personnel department that what we wanted to do met their classification standards.

For me and the key members of our management team, these circumstances gave us a rare opportunity to apply all the lessons of past training and experience to the establishment of an effective physical plant organization; at the same time we've known that if it didn't work out, there was no one to blame but ourselves.

I might begin by briefly outlining where we were:

1. We had a Department of Buildings and Grounds of about 570 people. It had good, competent people and supervisors in all of the basic trades and skills of facilities maintenance and maintenance services, divided between a central shops organization and a virtually independent, duplicative Medical Center Maintenance group. It had a professional managerial staff of one--the director--and, with a few exceptions, virtually nothing in the way of management systems or procedure. To exaggerate ever so slightly, the management "system" was to wait for the phone to ring or the morning mail delivery to find out what had broken down and then send the guys out to fix it.

2. There were independent maintenance and utilities organizations at two outlying hospital sites.

3. There was an independent heating plant division run on a part-time basis by a member of the Mechanical Engineering faculty.

4. There were two separate and independent planning and design staffs, one University Division and one Medical Center.

5. Other independent components were a facilities engineer, and an energy conservation engineer.

Organizational Plan

Our organizational task has been to incorporate all of this into a single, coherent organization. These were our principal objectives:

1. To create a strong centralized management system and organization to achieve more effective control and coordination.

2. To build a management structure with depth, to provide clear opportunities and paths of development for our managerial staff.

3. To centralize and consolidate like functional capabilities.

4. To strengthen our management and operation of utilities plants and systems.

Our first step was to change the name; we decided to call it the Department of Physical Plant.

I like to joke that "we changed the name to protect the guilty," but there was actually a serious purpose.

1. After years of fighting with each other, we didn't want anyone to feel that his organization had been swallowed up by a rival one. Rather, we had all joined together to form a new organization.

2. We wanted to convey to the University community a message of change and reform.

To publicize the name change, we also applied it as rapidly as we could to signs, vehicles, employee uniforms, and the like.

The new organization was formed around five principal components, each headed by a director.

Physical Plant Management became the central, internal management "core" of our new organization, providing management services support to the entire department. Its four divisions are:

1. Administration and Cost Accounting, which provides personnel, administrative, cost accounting, and budget services to the department.

2. Work Management, which performs facilities inspection, does planning and estimating, manages the preventive maintenance program, and contracts for test and inspection, such as boilers and pressure vessels, elevators, or fire protection systems. Work Management also provides long-range maintenance planning and budgeting, and work reception, authorization, control, monitoring, and reporting.

3. Construction Management manages and inspects all external contracts, for both major capital budget projects, and routine maintenance, repair, and renovation.

4. Materials Management handles all departmental material procurement.

Planning is responsible for overall master and site planning, and landscape design, for the University.

Architectural and Engineering Services is responsible for the provision of all design services, whether by outside architects and engineers or by departmental staff, for both major capital projects, or minor renovations, and maintenance and repair when detailed plans and specifications are required. It has four divisions:

1. The University Architect, who manages all University Division projects.

2. The Medical Center Architect, who manages all health care and medical education projects.

3. Engineering, which manages or provides all engineering design or studies.

4. Design Services, which provides architectural design, interior design, and drafting services.

An important element of our organizational plan for Architectural and Engineering Services has been the establishment of a project manager system. Each major construction or renovation project is assigned a project manager, who is responsible for managing and coordinating the budget, design, construction, and all related procurements throughout the life of a project from inception to the completion and acceptance of construction.

Physical Plant Operations is responsible for the provision of all facilities and grounds maintenance, repair, renovation, and maintenance services, except utilities, including assignment, supervision, training, and development of personnel. Its principal divisions are:

1. A central maintenance division.

2. Separate branch maintenance organizations at three medical facilities.

3. Renovation (construction).

4. Building services (custodial and waste collection).

5. Landscape.

An important element of this organization is that all shop fabrication, and all major projects, are handled on a centralized basis. Branch groups provide only preventive maintenance and minor maintenance services.

Utilities is responsible for energy conservation and for the operation, preventive maintenance, and routine maintenance of all utilities plants and distribution systems, and for air conditioning. A forthcoming change will expand the responsibilities of the air conditioning group to add building heating systems as well. Its three divisions are:

1. Heating Plants, which operates and maintains three central heating plants.
2. Air Conditioning, which services, maintains, and operates all air conditioning installations, whether central units or individual units, and all refrigeration equipment; and operates the University's utilities monitoring and control system.
3. Utilities Distribution operates and provides routine and preventive maintenance services to heating, electrical, water, and gas distribution systems, and storm and sanitary sewers.

Lessons Learned

While a great deal of refinement and "shakedown" work remain to be done, we have now essentially completed the reorganization and staffing of the University of Virginia's Department of Physical Plant.

On the whole, we feel it has worked well, and that we are now well on the way to providing the quality of physical plant support that our University deserves. Nevertheless, there were a few things that didn't work out as well as they might have, and we have learned a few lessons from our experience.

1. Adapting the work force to change. Probably our greatest problem resulted from an inadequate effort to make sure that the whole organization was with us as we set out to change the organization and almost every management practice or procedure in it. We made the mistake of thinking all we had to do was to tell people what we wanted. Top level management came through all right, but many of the mid-level and first-line supervisors, and the clerks, accountants and the like that run day-to-day procedures didn't. Our new ways were not clearly understood. People got things wrong, and most quickly reverted to whatever procedures they were accustomed to following.

   It is essential, we learned, that new procedures be carefully documented, and employees thoroughly trained in them. Results must then be carefully monitored and periodic follow-up training provided.

2. How people react to change. We learned a lot about how receptive to change some people are; how resistant others are. We found that there is a pattern of group or organizational behavior that can be very positive if people see change as productive and good for them; or very regative if they feel that their position or "turf" is threatened. You have to be very sensitive to this, and take pains to communicate so that your people are with you.

3. Resolve is needed. Despite our best efforts to get everyone with us, we found we had people in key places who were resistant to the new program and systems. Rather than jeopardize our program, we made a few sudden changes in supervisory assignments.

4. Synergistic effect of consolidation. Our experience has reaffirmed my conviction that there is a synergistic effect in consolidation of like resources; that is, the strength of the consolidated group is greater than the sum of its parts. All of our consolidated groups are now much more capable of responding to major needs than we ever could with our older fragmented organization.

5. Communication with the rest of the University. Internal and external communication and coordination are the Achilles' Heel of any large organization, and special effort is needed to make sure they happen. We didn't overlook this need, but we didn't do nearly enough of it. People outside a physical plant organization, who only call on it on an occasional basis, can't be expected to remember how you've reorganized or who now does what. You must make getting responsive answers to questions and prompt service easy. We must use every available communications means to inform users of changes to our services or how to get them. A good services guide is essential. We will publish ours soon, and plan to republish annually.

   One promising device that we have adopted direct from the Navy's Public Works Centers, where it has worked well for years, is the Staff Engineer. We have appointed two--one for our Medical Center, another for the University Division. We still encourage direct contact with responsible managers, but the staff engineer is a single point of contact, a sort of focal point, responsible for keeping users informed, for managing and coordinating the provision of support services, for getting answers and resolving problems in any component of the physical plant organization. The concept is new, and we are trying to make these "high profile" positions.

Managing the Physical Plant Department in a Businesslike Manner

By Harry F. Ebert
Lockwood. Andrews & Newman, Inc.

Introduction

Those of us who have worked decades on university campuses with physical facilities have repeatedly heard that we should manage our affairs like it was a business. Some appreciative members of the academic community have been known to say such things as "that is a businesslike bunch and they will give you all the support they can". Some other less complimentary adversaries in the same community might say "boys! if you tried to run a business like this you wouldn't last a week". There is **factual** basis for both comments. A most interesting observation is that a high percentage of academia uses the "business world" to measure the performance of the physical plant department on their campus.

Measurement by comparison is the most common of all measurement schemes. Weight is usually expressed as a multiple of some standard mass such as the gram. Distance can be expressed as some multiple of the meter. Some abstract things such as time also have a standard reference. It is unfortunate indeed that we have not developed similar standards for management performance.

In groping for a means of expressing levels of management performance, there is frequently the implication that being businesslike is something to which plant managers should aspire. Such an implication can be summed up as an unguided, and probably uninformed, thought. There are some well-managed businesses. There are also a number of poorly managed ones.

"Business" has a measurement tool that the university physical plant department doesn't have -- profitability. In general, any commercial or industrial enterprise that produces a continuing, good return on investment and maintains a highly probability of a long term future is viewed in the profit-oriented community as a well-managed business. Conversely, a management style that averages a minimum profitability, or does not project a prosperous future is viewed with doubt by its peers.

APPA members have spent countless hours and gone to great expense to find a comparative tool for measuring management performance. At this time we don't have such a tool as the profit and loss statement. The biennial comparative cost study and the parallel staffing report done by APPA is an effort to develop some means of measuring the degree and level of physical plant administration. These reports are valuable tools, but they are far from comparative measurement. The fact is we don't have a "bottom line" measurement in physical plant that is equivalent to the profit and loss statement that profit-oriented businesses have. Until future generations devise some scheme we have not yet discovered, we will continue to grope and depend on some indirect comparisons.

Even though we don't have the ultimate scheme, there are some things we can do in the meantime that will guide administrators in a desirable direction. If our learned professors in all their great wisdom are going to compare our operations with profit-oriented business, ill advised as that may be, it will behoove us to look closely at good and bad business to see why some are good and some not. Then go one step further and examine elements that might be compared with those in a university physical plant department.

Rate of Return

Private business, regardless of its product, is fundamentally an investment business. The owners and stockholders have invested capital to start and to build the business. Their objective is to make that investment pay dividends. If the investment is fruitful, there is reason to increase the investment. If it doesn't produce a return, something gets changed forthwith! It seems reasonable to recognize the capital investment the university has made in its facilities and then ask the question: what rate of return does the university get from its investment? The answer can't be in dollars, so what is the unit of measure and what is the rate of return of these units?

I submit that the return on a university investment in a physical plant should be a timely, effective and economical support service for the broadly defined academic program. The rate of return on the investment is, in most instances, what the physical plant department permits the campus recipients to believe it is.

In every business venture a predominant aspect is marketing. It is necessary to sell a product in order to generate revenue. This is obvious when one looks at a business that produces tangible products such as bricks, radios, paper, etc. It is not so obvious when the products are intangibles such as services. Services provided by the physical plant department frequently are not marketable as presented. Physical plant personnel are notoriously poor salesmen. Ever so often they produce what could be attractive services, but are criticized for poor performance instead. The difference between the recipients' attitude and what it might have been is purely a matter of presentation. The supplier of the service has a product that could be classified as "good", but the recipient was permitted to expect something different from what he got. So the recipient described the service as "bad". What is "good" or "bad" in campus facilities and service is greatly affected by what people expect. If you have timely, effective and economical services, they must be marketed. They won't sell themselves. The rate of return on campus investment in plant and plant services will, to a large extent, be affected by your public relations competence. If the campus community is pleased with physical plant performance, then the university is getting a good return on its investment.

Know Your Product

Not very much of what we can create in plant management has any value unless we sell it. Ideas, services, finished structures, etc., will have little value until someone is persuaded to use them. In the profit-oriented world this is very obviously true. Sales and marketing are primary elements in every businesslike activity. In order for anyone to market his product he must first know the product.

How much do you know about your own physical plant, its operation, and plant services? Do you have a process or procedure that periodically provides you factual information about your activity as the campus community view it? Do you really know what you are doing to or doing for the campus? Are you certain that you are properly represented when your staff goes out on the campus and acts in your behalf? Unless your answer is yes, you're in trouble. A well-run, profit-producing business invariably has some diligent procedure to investigate and evaluate what the customer thinks of the products. Without consumer research, product design and quality control can't exist. Without consumer research, the physical plant department won't get the administrative support that it so desperately needs.

A rarely practiced but highly recommended procedure for physical plant administrators is a routinely periodic visit with academic staff, other administrators and students. It may seem risky to some, but just asking your customers on a recurring basis "How are we doing?" can provide excellent feedback on your product. You may not like some of what you hear. However, such a procedure will uncover facts that are necessary for good operation. The same procedure will also bring to light the source of the misinformation that can be so detrimental. But just discovering facts and sources of misinformation is not enough. This kind of data must be a cause for action. It should be a means of improving your product -- timely, effective and economical services. You must know your product before you can sell it or improve it.

One of the most irritating occurrences to consumers of material goods or services is late delivery. Each of us can recall situations in which we were told or were permitted to expect delivery of a finished product at a specific time only to find it didn't happen that way. Almost without exception, this caused unnecessary confusion, secondary delays, added cost or inconvenience and caused us to question the integrity and competence of the supplier. The delay invariably develops a serious question in the mind of the customer about alternate sources of supply for future orders. Repeat business is a highly coveted activity in a profit-oriented business. It should be in the physical plant business, too.

A well-run business of any kind as a system of monitoring completion of services or delivery of products. A good work order control system can do this for physical plant. Regardless of the system used to identify later deliveries, the cause of delay should be determined any time it occurs and some action taken to avoid recurrence.

In my experience the most frequent cause of later delivery or late completion is failure to know capacity of the producing department. Overcommitment can be just as devastating as undercommitment. It is vital to a profit-oriented business to know realistic completion dates and commit to them only. Don't let an overanxious client commit you to a schedule you can't meet.

Know and Control Costs

For reasons I find difficult to justify, most universities assess less than actual cost to departments which use our services and facilities. It is a very common practice for physical plant invoices to omit labor costs completely or to bill them at raw salary cost. It is a common practice to not assess any cost for use of utilities. You would not be the first if you were to build some research gadgetry for a department, connect it to major power and water supplies, have the researcher let the monster overwhelm air conditioning with waste energy while dumping hundreds of gallons of good domestic water into the sanitary sewer -- and you then send him a one-time invoice for materials only. Unfortunately this sort of unrealistic occurrence is common on campuses. When the user is not held accountable, he doesn't care what costs are and he makes no effort to control them. This forces the physical plant department to compete for dollars at the budget table so other dollars can be wasted without control. Most universities could greatly improve their financial performance by knowing actual costs and then allocating those costs to the activity that creates the expense.

In my first year at the University of Houston, the physical plant department was requested to provide special events support to a national meeting of directors of campus placement personnel. Physical plant provided special set-ups in meeting rooms, audio-visual equipment, transportation for delegates and all the other usual items for a meeting of campus professionals. In prior years physical plant could not bill for services. I persuaded a change in the system. At the end of the meeting I presented a detailed invoice for all of the departmental services. After reading the invoice our placement director gave a classical response: "If I had known I was going to have to pay, most of this would not have been necessary". In order for any business to function in any kind of ongoing situation it is mandatory that true costs be known. The costs are reflected eventually in the price of the product. The price of the product rules the activity.

It is indeed true that no business can prosper without factual knowledge about costs or without some means of controlling these costs to a competitive level for equal products. Physical plant is no exception. You must have a cost accounting system that reveals true costs in a way and in places where controls can be exercised.

Know Your Markets and Your Clients

Changes in progressive organizations are seldom made quickly without some substantial forfeits. However, changes are necessary if the organization is to continue to be progressive. To avoid disruptive actions, needs should be predicted sufficiently in advance to allow orderly changes and adjustments. In the profit-oriented business community we must keep informed about the future of our markets to stay prepared to meet demands or not get caught with an excessive inventory. Either can be disastrous. The more accurately we predict our staffing needs, our production capacity and our feedstock requirements, the higher our profit margin will be. I believe the same is true in physical plant.

How will you predict your staffing, shop, transportation and material needs if you don't know of pending construction projects; remodeling; student, staff and faculty population projections; research projects; public service activities and new programs? I don't think you can. It is imperative that you know your market, too.

Of course, markets don't sign orders. People do. Knowledge and fluency in your market are vital, but they alone aren't enough. It is well to know what is pending and what the activity level will be in general terms. But the client, customer or user determines your share, the time constraints, and, in a broad sense, how you must perform if you want to stay in business. Frequent client contact is vital for continuing good relations. When you make a client contact, take the steps to insure two-way communication. In order for you to know your client and for him to know you, you must hear him and he must hear you.

Know Your Competition

The American way of life has in part been founded on free competition. Competition is one of the strongest motivators for development of new and better products, more effective services and customer appeal. It is also one of the most effective controls of cost to the consumer. If we are going to equal or out-perform our competition in order to retain our share of the market, then we have to know what our competitors are doing.

I think that a well managed physical plant department must recognize that the campus community has available alternate sources of facilities and support services. For the department to set reasonable goals and objectives they would be advised to identify the alternates and to compare their own products with those of competitors.

As only one example, look at custodial services. There are firms that will offer to provide services for fewer dollars than you currently spend. These firms are some of your competitors. If they are cheaper, should you employ them or not? That question can't be answered properly without knowing more than price. A logical response can come only if all aspects are considered and it is established that the prices quoted are for equal products. The logical response depends on your knowledge of your competitors' ability to produce and your ability to compare his service with your own. As in the profit-oriented business community, physical plant must know its competition if it is to function progressively. Currently there are purchased or contract services available for just about every phase of physical plant activity. In order for you, the manager, to know you are getting maximum benefit from every physical plant dollar you must know your competition.

Remember You Are in a People Business

In today's turbulent economy there are many temptations to react to immediate pressures without giving proper consideration to long term consequences. Some of these temptations adversely affect material things. Some affect intangibles such as student attitudes, faculty productivity, employee morale and public image. In a profit-oriented business we have comparable concerns for client attitudes, staff productivity and morale and our public image.

Everything we do in the business world and everything you do in physical plant interacts directly or indirectly with people responses. From one point of view, we can say all of us are in a people business. Our success or failure will ultimately be determined by people and not by buildings, streets, power systems or transportation. It is a profitable objective in every business to shape our output to the needs of people rather than attempting to shape people to fit our output.

Conclusion

Physical plant operation and maintenance is indeed a business and deserves to be treated in a responsible businesslike manner.

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